JANUARY 27, 1958 PRICE 50 CENTS

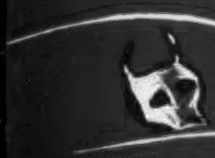
Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN
RESEARCH AND DEVELOPMENT

R and D edition
RESEARCH
DEVELOPMENT

SO YOU WANT TO WORK ABROAD!

see page 34



DESERT SCIENTISTS?...

see page 23

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Product Engineering's **Index for 1957 is now on the presses and will be ready for distribution on February 15.**

- *The Index has been expanded to include all major articles and news items appearing in the R & D edition as well as those in the Design edition.*
- *There will be a separate Author's Index, as well as a Table of Contents for the Design Digest Issue—Vol. 6.*
- *To provide space for the more than 800 new entries, the Index has been expanded to 16 pages.*

Copies are available, while the supply lasts, on request to the Reader Service Dept., Product Engineering, 330 West 42nd St., New York 36, N. Y.

coming next week . . .

the DESIGN edition for February 3

FEATURING:

- **When pistons need brakes.**
  How to take the bang out of end-of-stroke forces in hydraulic cylinders.
- **Those smaller motors with same power.**
  New NEMA standards for 40- to 125-hp motors as seen through the eyes of a motor designer.
- **New standards for fiber-reinforced plastics.**
  Fourteen companies set up cooperative program to derive design data.
- **Chemical milling.**
  First available design data for large-scale production of parts.
- **Ball bearings for 300 F and up.**
  How special materials and lubricants reduce obstacles to good performance.
- **9 ways to make instruments readable.**
  What causes trouble and how to get around it.
- **Multi-function overrunning clutches.**
  Seven examples of "full-employment" clutch rings that do more than one job.
- **How to calculate stress in short shells.**
  Formulas for deflection, shear force and bending movement.

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

R and D Research and Development edition

January 27, 1958 Vol. 29, No. 4

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Product Engineering ..... SIDELIGHTS

R&D edition — Research and Development

France

● **A homey note just** in from London should be added to our report on engineering jobs in England (p. 34). It seems the Queen has mice, and that's official. The new list of royal warrant holders—people who are entitled to advertise "by appointment to Her Majesty" includes the name of the British Ratting Co., a rodent-control firm. A company spokesman said his men catch mice for the Queen in her private houses and country estates. Buckingham Palace mice, however, are the responsibility of the Government Ministry of Supply.

● **Rumblings among engineers** in the Southwest (see p. 23) may, in part, have been instigated by some rather annoying security measures. The Oklahoma City Times reported late last year that two Army men attended a Navy Conference wearing tie clasps of a top-secret Air Force missile. Said clasps were immediately confiscated by operatives of the Office of Special Investigation and some 200,000 clasps were recalled from circulation by a well-known aircraft manufacturer. OSI operatives are hereby warned to keep their cotton-picking hands off our space-ship tie pin.

● **If you need some empty dog-food cans,** get in touch with Sandia Lab in Albuquerque. Seems they had a critical problem of maintaining temperatures constant in air-storage tanks used for a wind tunnel. When the 300-psi pressure was released, the temperature dropped to —60 F. By packing empty tin cans in the storage tank they figured to retain enough heat to warm the air as it decompresses. They ordered a carload of empty tin cans—and it worked! "The big problem now is what to do with the 28,000 empty dog-food cans that were left over."

● **The reference to "barns"** (see p. 7) as a measure of nuclear cross-section stopped us cold. We always thought barns were gadgets to keep cows in. Seems somebody thought a cross-section like samarium's 500×10^{-24}cm² was pretty small. "Heck no," said a well-known physicist. "It's big as a barn door." So now you have a measure of barn-door area: 1 barn = 10^{-24}cm². Small, maybe, but precise.

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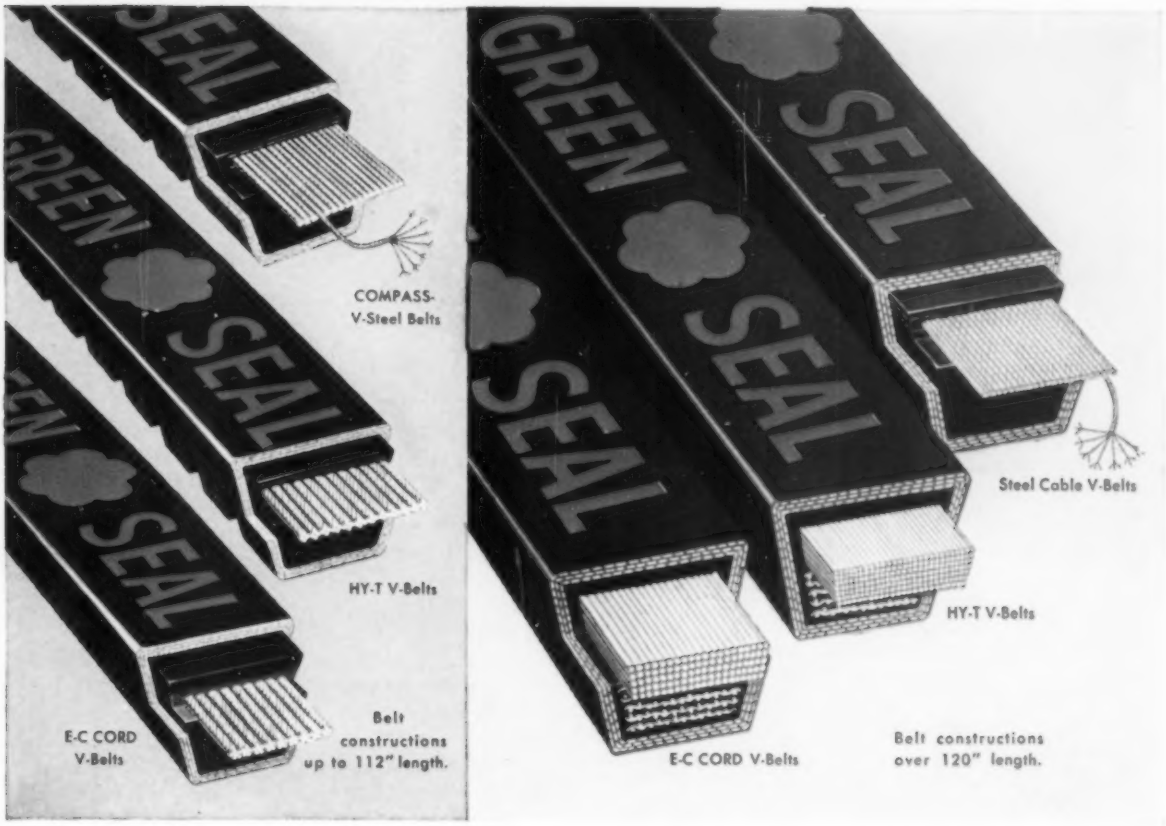

Until recently dimensional stability was possible only in V-Belts with steel load-carriers as developed by Goodyear. But now you can have that stability in a complete line of belts – thanks to the development of Triple-Tempered (3-T) cord–synthetic cord tempered by Tension, Temperature and Time.

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READER TO EDITOR

EDITOR'S NOTE—The following extracts are typical of comments and added data included in dozens of letters commenting on the editorial "Why We Need to KNOW" in PRODUCT ENGINEERING on p. 24 of the Dec. 16, 1957, issue.

Another Look at Russia

To the Editor:

"Why We Need to Know" hits the mark. In competing with Russia it seems to me that we impose upon ourselves some serious handicaps. In Russia, higher education is available to all who qualify, on a competitive basis; and regardless of sex, color, or ability to pay. We read about the keen competition that now exists for admission to American colleges. But the following groups in our country are largely eliminated from this race: 1) Families in the lower economic group cannot afford to support a son or daughter through four or more years of college. 2) Families in the middle income group often cannot afford to send all their children to college. 3) Fifteen million colored Americans often get an inferior high-school education. 4) Women are discouraged from entering the field of science and engineering by the popular notion that they are unfit for such jobs. And like the colored citizens, they are faced with the prospect that most jobs would be closed to them regardless of ability.

How does Russia compare? An article in *USSR* magazine, Issue #7, produces the following facts: From 1956 to 1960, the Russian colleges will admit 1,200,000 students, chosen from among 6,300,000 high-school graduates. Entrance exams are uniform. Students pay no tuition fees. Eighty percent of Soviet students receive a stipend to support themselves. Priority for this stipend is given to students with high marks in the entrance exams. The amount varies with need and course of study. The same amount is paid during vacation.

The Russians call this socialism. It might well be called "equality of opportunity" or "democracy." But whatever we call it, can we do less and expect to match them in numbers and quality of BS's, MS's and PhD's?

—DOMINIC MASCIO
Bellrose, N. Y.

. . . After all the hand-wringing accusations and second guessing printed about our scientific lag, this was most refreshing. I tip my hat to this effort and say well done.—LEONARD ARNOW
New York City

. . . For Canadians and other foreigners, it has long been a matter of mingled amusement and irritation that U.S. news services consistently print only news that is palatable and flattering to the U.S. public while suppressing or distorting the real truth. If the grains of wheat in this and similar articles are not lost in the general chaff from the U.S. press, there is still some hope for the future of your country and the rest of the free world that looks to you for leadership.

—JOHN G. SPOTTON
John Spotton Co., Ltd., Toronto, Canada

. . . If the grasping pressure groups could be pushed out of Washington and away from the pork barrel, there would be plenty of funds for the necessary defense projects and the educational assistance for those who need it and are qualified to make good use of it. —A. N. MONTGOMERY
Montgomery Manufacturing Co.
Owensville, Ind.

We Need A Cool Appraisal

To the Editor:

The repugnance of the essential nature and political acts of the Russian social system must not blind us to the technical competence and achievements of their science and engineering. No informed people have doubted this competance, nor have been unaware of these achievements. But these powerful tools, in hands that we have every reason not to trust, need really be feared only if our own technical potential in the fields of pure and applied science is impeded and insufficiently used for our ultimate safety and benefit.

My 25 years of experience as a development engineer have made me acutely conscious of the need for the results of research. Without new knowledge we can only redesign bigger hubcaps—more chrome plate. Perhaps PRODUCT ENGINEERING should display as a catchword part of the title of your article—We Need to Know. —JOHN R. TURNER
Rochester, N. Y.

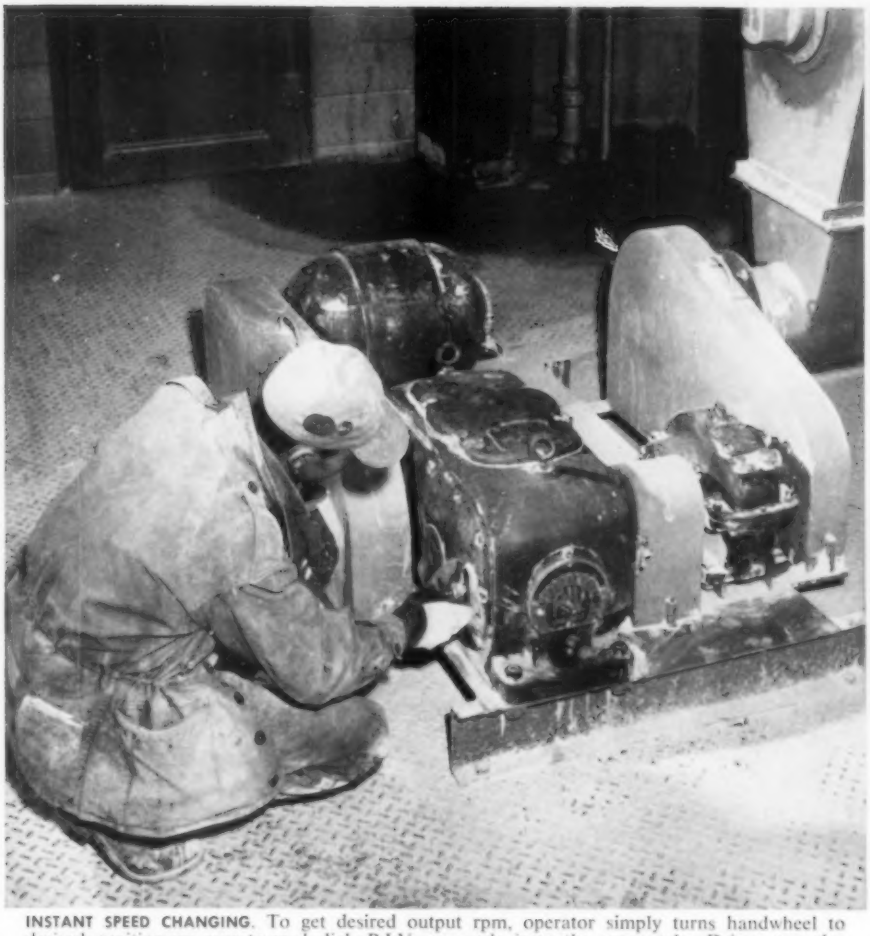
. . . A most deeply favorable impression in our department. Do continue the excellent work.

—HAROLD M. LESTER
Manufacturing Research Dept.
Burroughs Corp., Detroit

. . . May I congratulate you on your clear and forthright statement of the facts. I'd like a number of copies.

—JOHN M. NALLE
Belmont, Mass.

Reprints of the editorial, "Why We Need to KNOW" are available free from Reader's Service, PRODUCT ENGINEERING, 330 W. 42nd St, New York 36, NY., in limited quantities.



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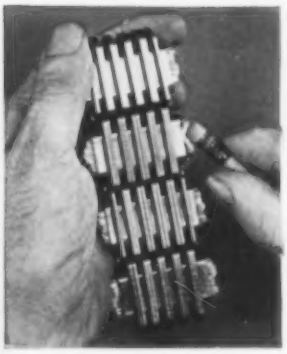

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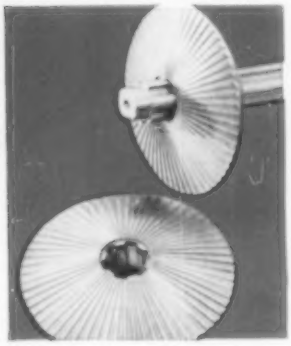

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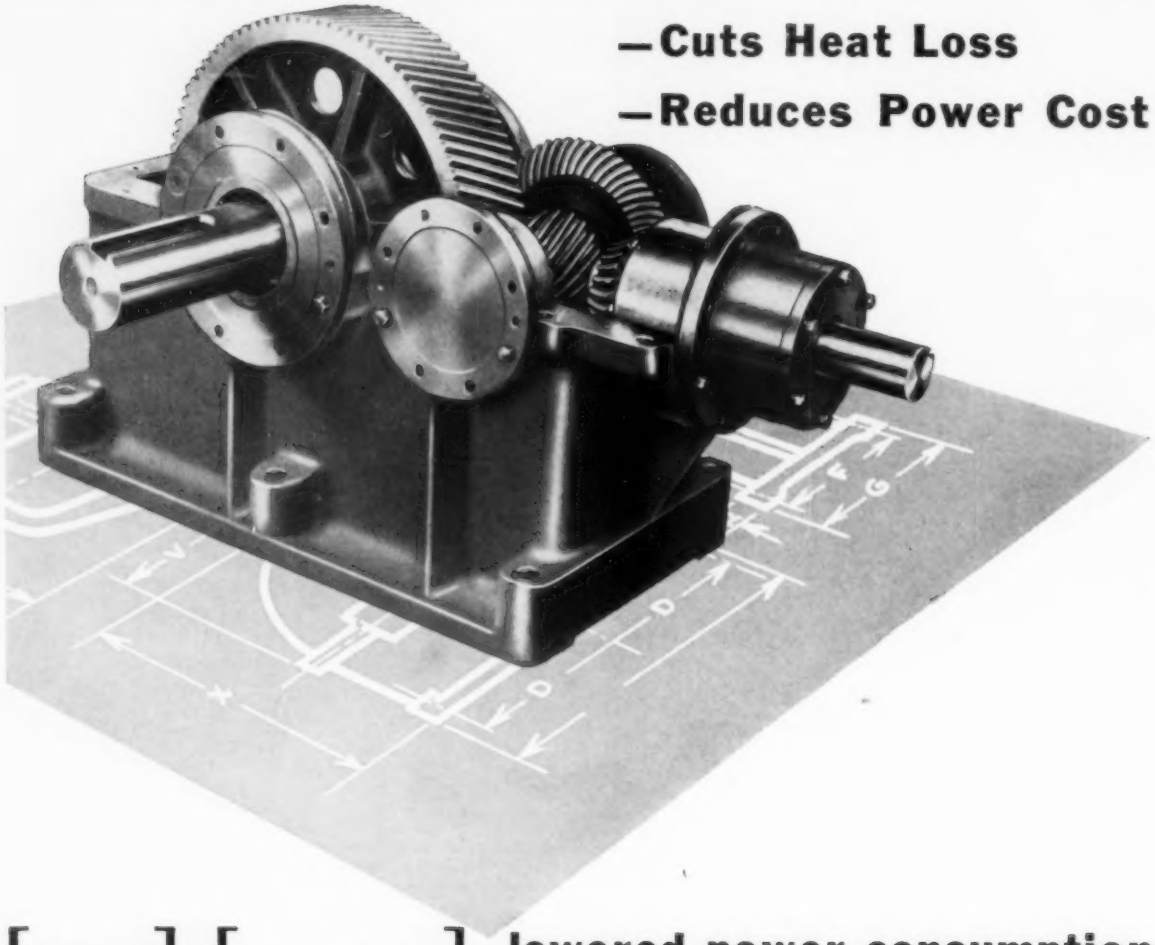

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American...

DEVELOPMENTS TO WATCH...

Samarium is looking for jobs . . .

. . . This rare earth is by no means abundant. But as a result of atomic-energy demand for its sister elements, gadolinium and europium, developmental quantities can now be obtained. For example, Lindsay Chemical can now supply samarium and its oxide on special order, in purities of 95, 99, and 99.9%, as well as lower-grade concentrates.

Samarium is element number 62 (atomic weight 150.35). It has a melting point above 2400 F, density of 7.54 gm/cc, and shows a rhombohedral crystal structure. It's paramagnetic, and has a high neutron cross-section (500 barns). Chemically, it's similar to the other rare earths.

The sesquioxide (best-known compound of the material) has a density of 7.43 gm/cc; melting point above 4300 F; dielectric constant 21.5; power factor 0.03%.

Where can the element and its compounds be used? Lindsay doesn't know; but would welcome inquiries from anyone who has an idea.

Clue to plastics trends . . .

. . . are recent announcements of plant openings and closings by leading materials suppliers.

Polyethylene and its polyolefin relatives still lead the expansion parade, with new plants (for "regular" as well as "linear" types–see PE–Nov. 18 p. 17) slated to put capacity over the billion-pound mark. (Last year's production: 635,400,000 lb.)

In nylon molding resins, the big news is variety–at least three basically different types soon to be available (PE–Dec. 23, p. 76).

Phenolics, once written off as "dead" or "dying," have shown little or no expansion for several years. Now, their excellent heat resistance has been rediscovered, they've proved able to withstand nuclear radiation, new types have been developed, and phenolics are off to a new start in everything from computers and missiles to home appliances.

Polyesters are getting the write-off treatment now, result of announcement by one major supplier that it's getting out of the polyester business, will concentrate on epoxies. Other suppliers point out, though, that polyesters still have advantages: They're water-white, can be given almost any color. They're available in a wide range of formulations, flexible and rigid. And they cost about half as much as the epoxies do. Epoxy use will certainly grow, though, since these materials are superior in adhesion to glass and metals and have a low shrinkage factor (characteristics particularly desirable in coatings and potting compounds).

Shriek-proof design . . .

. . . for high-speed transportation calls for new combinations of materials, and more-thorough testing, Convair engineer J. F. Woodall points out. To keep both weight and cabin noise down, Convair is now making extensive use of foil-faced glass fiber insulation and other relatively new combinations; but it's also testing every element of fuselage design for its sound-insulating ability–starting with bare skin panels, and then testing each section as it is built up. One helpful factor: The passengers themselves will serve as sound-absorbers, help keep the noise level down ("unless, of course," Woodall says, "they all start talking at once"). In fuselage testing, Convair uses chunks of glass fiber to simulate people.

Octave-band noise analyzer is used by Convair engineer to measure sound level in specially built 19-ft section of Convair 880 jet transport

American...

(continued)

DEVELOPMENTS TO WATCH...

New tire types are on the way . . .

. . . One source is Armstrong Rubber Company. It's already testing the all-butyl tire in conjunction with Esso Research & Engineering: will soon introduce an improved first-line truck tire, and is experimenting with a new "high-flotation low-profile" design for light commercial vehicles. The latter, originally developed for Army Ordnance, is said to offer improved maneuverability on soft ground and sand, and good traction on uneven surfaces. No date has yet been set for commercial introduction.

Dangerous trends in product styling . . .

. . . are "ersatz opulence" and non-functional speed symbols, says F. Eugene Smith, secretary of the American Society of Industrial Designers. He concedes that many new home appliances feature a crisp, rectangular, sharp-cornered, lightweight look. But some products, notably in the automotive, boat, and furniture field, seem to be going in the direction of "American Baroque." Says Smith, "Features which started as an inspiration towards a look of speed in automobiles have now taken on a life of their own"; among these are high tailfins, escape "jets" and rocket-shaped body gashes. "We have reached a dangerous impasse," he feels, "when speed symbols no longer serve any functional purpose," yet dominate the design of a product.

What's "ersatz opulence"? He cites the "solid-gold interior" of one airplane, and the use of gold-colored thread just because it is now available, "on some products for which gold is neither appropriate nor beautiful."

New crystals for optical, electronic . . .

. . . and nuclear use are planned by a company newly formed to specialize in "research, development, and production-growing of single crystals." Among crystals available soon are optical sodium chlorite, lithium fluoride, potassium bromide, and potassium chloride; electronic silicon, germanium, barium titanate, and indium antimonide; thallium-activated sodium and cesium iodides, europium-activated lithium iodide, anthracene stilbene, and terphenyl crystals for nuclear use. Standard size will be 5 by 11 in.

The human brain is a bargain . . .

. . . in weight as well as cost compared with even the smallest and most efficient computers, North American Aviation engineers point out. They cite comparisons which represent important goals for designers of equipment-of-the-future:

- The human brain is capable of memorizing up to 100 million "bits" of information. The largest computers now available to industry—room-sized gadgets requiring tons of air conditioning and kilowatts of power—have a maximum storage capacity less than $\frac{1}{5}$ as much.
- A transistorized computer with a capability approaching man's for even a limited variety of jobs requires at least 70,000 w. of current. The human brain takes only 100.
- A human pilot can endure—and operate efficiently for a half hour or more—at 200 F; for at least a quarter hour at 235 F. Little of today's electronic equipment can do the same; and some aircraft metals —aluminum, for example, begin to lose strength at temperatures as low as 200 F.

NAA's conclusion from these facts? In planning future aircraft, NAA engineers are designing man *into* the "driver's seat," not out. But they're continuing their research on materials and designs that can better match his performance.

New materials for coil-wrapping . . .

. . . are being developed by users as well as suppliers. One company, for example, is embedding wire mesh between two layers of heat-sealable polyester film (of a type normally used for packaging), then cutting sheets and strips to fit. And silicone-rubber producers are now offering a self-adhering tape that conforms to coil contours, sticks tightly to itself, but is almost completely nonadherent to other materials.—ARG

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— if it's an MPB bearing — is exactly like any other of its kind, minted with magnificent, miniature precision.

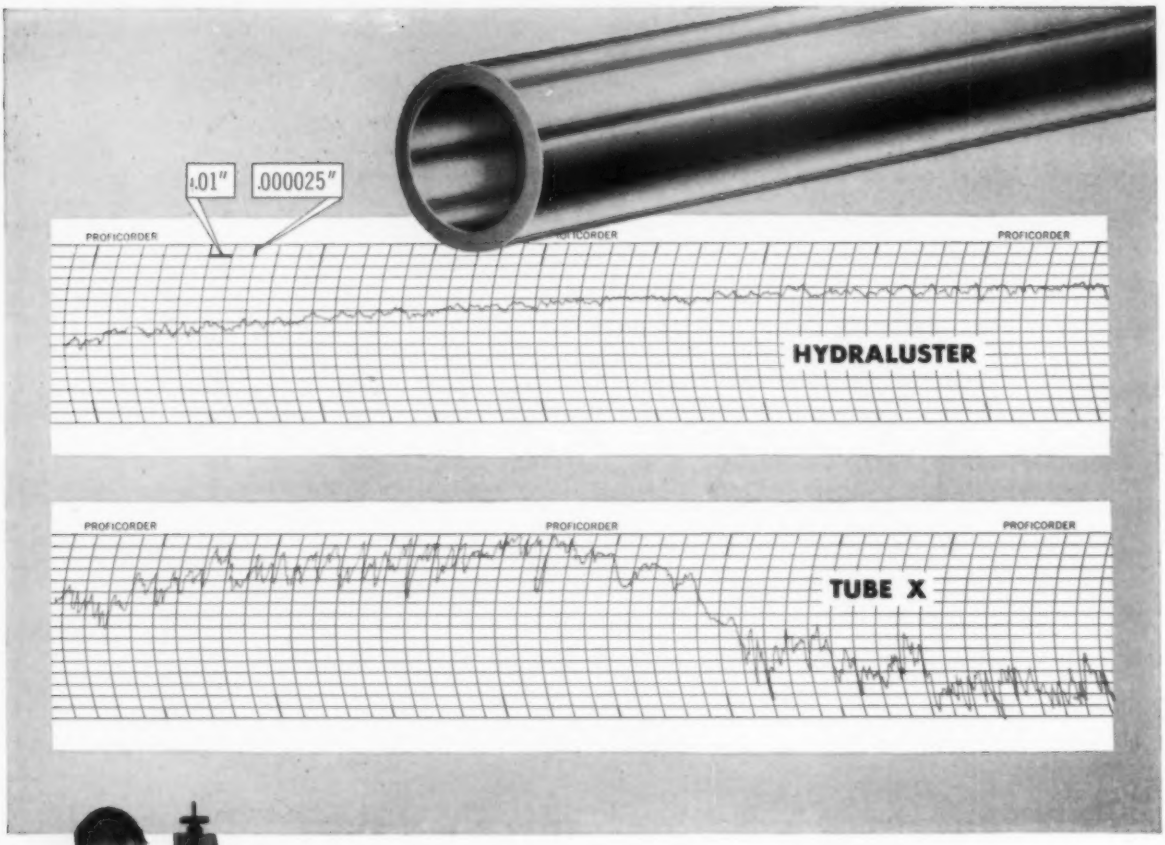
If your money comes from making precision equipment, you'll want to know more about the profit-producing powers of Miniature Precision Bearings. These bearings improve instrument sensitivity and reliability — heighten values and often cut costs.

Now possibility and perfection can replace impossibility and imperfection. There are MPB bearings from ⅜" O.D. down — precise within limits one-third the thickness of a postage stamp! Despite its minuteness every ball in an MPB retainer-type bearing rolls in its own coined pocket. Even under extreme temperature changes MPB bearings run smoothly, helping your product deliver continuous precision and top performance.

If miniaturization can help you, so can MPB. Over 500 kinds of bearings — specials if you need them. And we are ready with the world's broadest miniature bearing experience (we own the mint!) to solve your problems and help you mint ideas. Write to Miniature Precision Bearings, Inc., 201 Precision Park, Keene, N. H.

MPB

MINIATURE PRECISION BEARINGS



VERIFICATION: Measurements of Hydraluster and Tube X were made on The Proficorder—an instrument of our manufacture for accurately showing the true profile of practically any machined or finished surface. The tests were conducted in our laboratories under my personal supervision. And I verify that both tubes were measured under identical conditions. The resulting graphs show the exact differences in the samples furnished. **Douglas Palmer — Chief Inspector, Micrometrical Mfg. Co., Ann Arbor, Mich.**

In micro-inch comparison of hydraulic tubing . . .

HYDRALUSTER shows smoothest, most friction-free I.D.

These graphic red lines are recorded measurements showing a surface profile *inside* both HYDRALUSTER and a length of standard hydraulic tubing. *Both tubes were selected at random from warehouse stocks*, then accurately measured in microinches by the sensitive stylus of the famous PROFICORDER.

Hydraulic system efficiency and dependability, in a large degree, depend on factors illustrated by the red lines. Tube X is *not* a scrap piece of tubing. In fact, it represents a quality grade purchased and used every day. Which tube would you select to offer the least resistance to hydraulic flow . . . to transmit fluid with the least amount of pressure drop . . . and to create the least fluid turbulence?

Hydraluster is the answer, of course. And Hydraluster is the right tube to specify when you want to insure these same performance characteristics in your hydraulic systems.

SAMPLES AND SPECIFICATIONS: Examine Hydraluster finish yourself. Your name on company letterhead will bring specifications and a sample by return mail. *Hydraluster is sold at standard carbon hydraulic tubing prices.*

Summerill

Tubing Company Division-Columbia Steel & Shafting Co.

PITTSBURGH 30, PA. DEPT. NO. 1-A1

District Offices: Buffalo • Chattanooga • Cleveland • Dayton • Hartford • Philadelphia • Pittsburgh • Milwaukee • Chicago • Los Angeles • San Francisco

American ...Washington

DEVELOPMENTS TO WATCH...

Stainless steel beat out titanium . . .

. . . in the Air Force's recent contract to North American Aviation, Inc. for development of the WS-110-A chemical bomber.

Officials won't say just what importance the metals part of the program played in the contract decision. But, it is known that North American's plane will be built from stainless steel, and Boeing's plane was to have been made from titanium.

The contract, reportedly valued at close to $100 million, calls for building two or three prototype planes within the next three years. The plane will be designed to fly at a max speed of around 2200 mph—three times the speed of sound—at a flight ceiling between 70,000 and 100,000 feet.

It will use high-energy fuels rather than petroleum-based fuels, probably pentaborane, a liquid hydride of boron. It is 10% lighter than gasoline and has a 40% gain in thermal heat per lb. of fuel.

Four-year "emergency" aid-to-education program . . .

. . . proposed by the administration falls short of Congressional and educator's desires and is likely to have tough sledding on Capitol Hill.

The program, endorsed by the President and stressed strongly in his State of the Union message, calls for the Federal Government to spend some $1-billion over the next four years. This would be partially matched by states with another $500 to $600 million.

The four-year plan calls for pumping money into 40,000 scholarships, 5,500 fellowships, higher teacher pay, more modern equipment, and foreign language instruction. Annual cost of the program would run around $225 million, including some $65 million for the National Science Foundation.

But, the National Education Association wants a bigger program—closer to $1 billion in federal outlays for the first year, and expanded to around $5 billion in the next five-year period. Other Congressional proposals, too, call for more spending.

There are danger signals out for any school-aid legislation, however. Though Congress, sparked by recent Soviet scientific gains, will want to spur education in this field, educators are trying hard not to let the scale be tipped too much in this direction. They favor more across-the-board programs without singling out any one field.

Sure to show up on legislation, is the integration issue, and possibly the church-state conflict.

Outlook now: federal assistance for educating more scientists and engineers seems a good bet this year if the many pitfalls can be avoided.

Driverless trips by automobile . . .

. . . are held possible in the near future. That's what engineers from RCA labs at Princeton, N. J. predicted before a recent highway-research board meeting in Washington.

Envisioned is a system of electronic controls that would take over from the driver. Three basic elements are involved: a detector system noting the presence of the vehicle on the highway, a signal advising other drivers of the vehicle's location, and a steering setup to keep the car in its proper lane.

RCA has recently set up a 300-foot test section near Lincoln, Nebraska. The system works like this: a series of electronic wire loops buried in and along the highway detects vehicles, warning equipment goes into operation alerting other vehicles. Finally, automatic guidance is accomplished by having a cable in the center of the lane activate a pick-up coil in the vehicle to control its steering and speed.

Congressional probes into government R&D programs . . .

. . . will spread beyond military projects. That's the intent of the House Committee on Government Operations which has already called in Dr. Detlev W. Bronk, President of the National Academy of Sciences and Dr. Alan T. Waterman, Director of the National Science Foundation.

Before the hearings are completed the Committee will listen to a long list of "eminent and informed" men in research and development. Net result is to be a complete re-evaluation of government R&D programs in the terms of money, organization and management.

World-wide ...

DEVELOPMENTS TO WATCH...

An electronic control system for buses . . .

. . . will soon be operating in London. Photocells and an electronic amplifier, located on street-light posts along the bus route, will "read" a special code number on the side of each bus as it passes, and relays the information to a central control room. From here, controllers, acting on the information supplied, can send instructions to traffic-control men on the road. British Information Service says the BESI (Bus Electronic Scanning Indicator) can handle as many as 250 code numbers a second.

Explosives will form tungsten . . .

. . . and other refractory metals in Russian factories-of-the-future as well as in this country (see Jan. 6, p. 56). Russian metallurgist Pokrovsky predicts that tungsten and molybdenum bar and pipe will be produced by feeding a continuous rod of explosive into a chamber lined with the metal powder. Force of the explosion will then "sinter" the metal —producing bar or pipe of desired size.

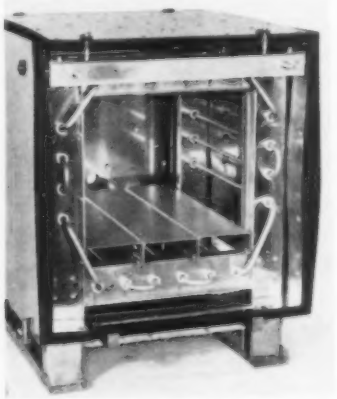
Rhenium metal is also under study . . .

. . . in the USSR, Moscow News Reports. They've found sizeable deposits of this rare metal in Kazakstan, are using it to plate rocket nose cones and engine parts. In the US, primary interest centers on electrical and electronic applications (Dec. 16, p. 6), but the reason for the interest is the same: rhenium's ultrahigh melting point (above 5700 F) and its retention of strength at elevated temperatures. It oxidizes in air at a relatively low temperature, though—about 1100 F.

Molybdenum and tungsten furnaces . . .

. . . for metals that require vacuum annealing at high temperatures are being built by Murex, Ltd. in England. Shown below, left, is a special molybdenum furnace lining; at right, a furnace built largely of molybdenum and with tungsten heating elements, for operation in the 3200-F range. The company is pioneering in fabrication of these metals, has produced spun tungsten parts (Nov. 11, p. 9) as well as spun molybdenum; is ready to supply tungsten sheet in thicknesses down to 0.002 in., molybdenum to 0.001 in. Tolerances range from 5% on sheet over 0.01 in. to 12% on the min. thicknesses. American agent for Murex is C. Tennant, Sons & Co., 100 Park Ave., New York 17.—**A.R.G.**

Special lining for high-temperature vacuum annealing furnace is built entirely of molybdenum by Murex.



Both tungsten and molybdenum are used in this high-temperture unit

A hose that takes extremes of heat and cold without cracking; attachable tire sidewall rings in white and a variety of colors for *extra* beauty in today's cars; and boots with superior resistance to weather and wear . . . all through the use of Enjay Butyl.

Enjay Butyl—*today's colorful rubber*

combines endurance and appearance for consumer products

With its versatility proved in a wide variety of industrial applications, Enjay Butyl is now making news in the field of consumer products. Available in non-staining grades for white and light-colored applications, it is helping manufacturers to market new products of *outstanding* durability in a wide range of attractive colors.

Where can Enjay Butyl work for *you?* Low in cost and immediately available, it may well be able to *cut costs* and *improve the performance* of *your* product. Enjay's newly expanded laboratory facilities, fully staffed by trained technicians, are always ready to help you find new applications for Enjay Butyl. For further information, contact the Enjay Company.

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Enjay Butyl is the greatest rubber value in the world. It's the super-durable rubber with outstanding resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

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What's happening in SCIENCE

More about those ductile ceramics

University of California researchers who first announced bendable ceramics two months ago (Dec. 9, p. 9) have now described some of the early tests leading to that discovery:

It has long been known, they point out, that salt crystals, extremely brittle in air, become ductile when placed in warm water. But that sparked little interest. Then UC started paring down the crystals, splitting a section off each face. It found that the remaining core could be bent by hand, for a short period, without need to "soften" it in water. The splitting was done in air. Soon, the core hardened—became as brittle as the original crystal. With these facts, the researchers went on—found the same effect in other cubic materials: magnesium oxide, potassium bromide, cesium bromide, potassium chloride, and lithium fluoride. They found, further, that the embrittlement noticeable in air also occurred in either an oxygen or nitrogen atmosphere, but not in helium or water vapor. And immersed in oil or some other protective medium, crystals would retain their ductility indefinitely.

The effect has not yet been fully explained (it's thought to be from some sort of interaction between the gases and points of high stress on the surface of a crystal), and it's unlikely that ceramics can ever be made as ductile as metals. But this does look like a breakthrough toward making ceramics much better for mechanical and structural use.

See-through crystals show magnet secrets

Rare-earth garnets (iron silicates containing smaller percentages of yttrium and other rare-earth elements) promise a helping hand in magnetics research, and may have direct applications in electronics as well. The reason: They not only have ferromagnetic properties, but are transparent—their internal magnetic structure can be visualized. This makes it possible to see the orientation of their magnetic domains, instead of just inferring it from the way light is reflected from their surfaces, or outlining the boundaries with magnetic particles. Furthermore, as Bell Telephone Lab scientists point out, the yttrium-iron garnet contains magnetic ions with but a single valence, and the internal magnetic structure can be studied over a wide range of temperatures and field conditions.

Aside from their research applications, these garnets (familiarly known as YIGS) are of interest because they have low activation-power requirements, and there is little loss in transmission.

briefs . . .

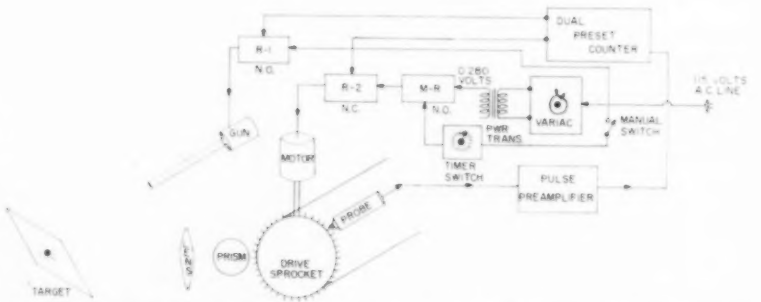
Standard ampere is holding its own, National Bureau of Standards reports. Tests after 15 years show a change of only a few parts per million. An ampere can't be preserved under glass as other standards can, must be created as needed from standards of voltage and resistance. But NBS says the new determination is so close to the old that the difference probably represents only a variation in measuring.

New radiation exposure limits established by the AEC will not immediately affect industrial operations, but they show the trend of the times. Under the new standards, an individual over 18 years old may not receive more than 15 rems in any one year, and should not receive an average of more than 5 rem per year during his working life. ("Rem" is derived from Radiation Equivalent, Man; is equivalent to the biological effect produced by one roentgen of X-radiation.)

Improved shielding material for atomic radiation is said to be twice as effective as concrete. It was developed by Japanese engineer Zenjiro Kusai of Kurashiki Mining Co., Okayama. The slabs, made by combining bentonite clay, cement, sand, iron, cobalt, and barium chloride, are "expected to cut cost of building radiation shields in atomic plants by two-thirds."

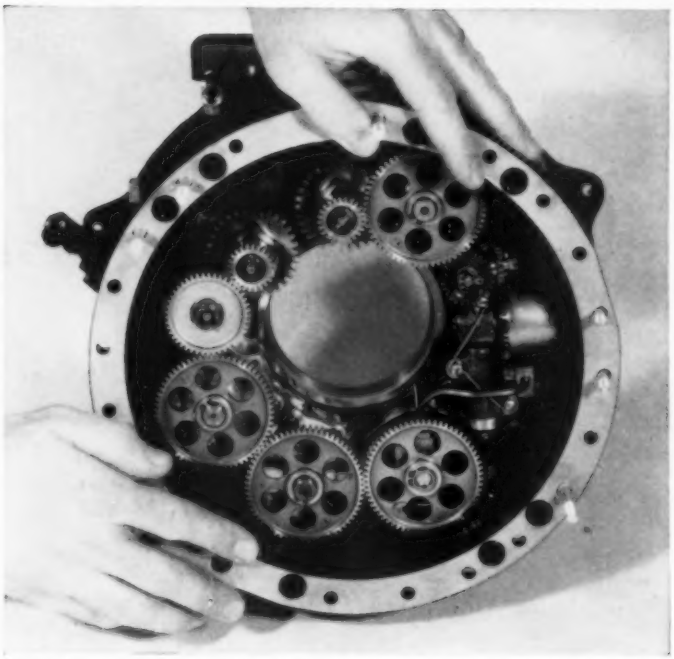
Snapping pictures in microseconds

Now that some motion-picture cameras can take pictures at framing rates up to 17 per millisecond, it has become a serious problem to synchronize the camera and the event being photographed. Naval Research Laboratory has an answer—the equipment shown here. It starts the film moving, counts the frames, and triggers the event after a preset count has been reached. It provides positive location of the picture on the film roll, to specific frames easy to find. —A.R.G.



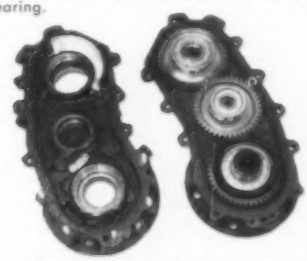
High-speed synchronizer for NRL camera works like this: Operator closes manual switch, connecting power to timer switch and activating mercury relay (M-R). Then, when film has been brought into position, first fast-acting relay (R-1) comes into play, initiating the event and the picture-taking. Another relay (R-2) shuts off power when counter indicates that film end has arrived.

Specialized Gearing-Engineering Solved These Design Problems

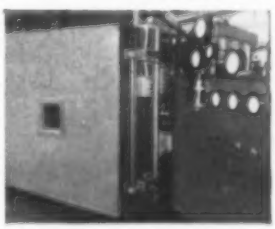


Precision gearbox assembly designed and produced in quantity by Sundstrand Aviation.

Integral bearing races, an innovation of Sundstrand Aviation *gearing-engineering*, overcome space-weight problem in this motor wobbler by eliminating bulk of a standard bearing.



Housing rigidity and strength maintained while achieving weight reduction in this Sundstrand *gearing-engineering design.*



600° F oil-in and 800° F ambient requirement met by high-temperature research on lubricants, seals, and metals at Sundstrand Aviation environmental lab.

Complete facilities for precision gear and gearbox production

When space, weight, and performance characteristics of gears and gearboxes are critical—or when designs are complex and difficult to manufacture—Sundstrand Aviation *gearing-engineering* and production capabilities are of particular significance.

Highly stressed gear trains for aircraft constant speed drives . . . gears . . . gearboxes . . . servomechanisms and controls . . . two-speed gearboxes with governors . . . special bearings and parts are typical of the production at Sundstrand Aviation.

Facilities for gear generating and grinding, machining, tooling and gaging, heat treating, engineering, materials evaluation, testing and research are new, modern, and extensive.

Complete information is contained in a booklet, "Sundstrand Aviation, a Source for Quality Aircraft Gears and Gearboxes." Send for your copy without obligation—use the convenient coupon.

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Division of Sundstrand Machine Tool Company

Rockford, Illinois

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2421 Eleventh Street, Rockford, Illinois

Please send booklet on your gearing facilities and capabilities.

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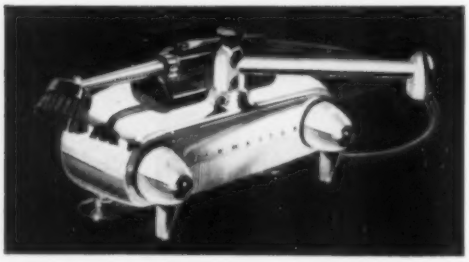
☐ Immediate interest ☐ Reference

FACT: *Copper and Brass . . . today's best metal bargains!*

Competitive analysis of metal costs in manufacturing "Dishmaster" dish washer device switched manufacturer back to brighter, more attractive brass and away from plated steel and other substitutes.

PROOF: *Manville Manufacturing switches back to Brass for a better product at lower cost . . . drops steel!*



Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The "Dishmaster" made by Manville Manufacturing Co. of Pontiac, Michigan, includes many small parts again being made of brass. Direct comparison of costs with cadmium-plated steel showed that brass was once again the bargain buy in metal. For example, cost of the retaining ring shown here was reduced $11.50 per thousand when the manufacturer switched back to brass! Comparable component savings are being made all down the line! (Based on October '57 costs of brass vs. steel.)

There's no excuse for using substitutes for copper and brass; the genuine article is today's best bargain in metals! Your nearest Chase man can show you specifically how Chase alloys—made of Kennecott copper—can fit into your production picture. Contact Chase locally or at Waterbury 20, Connecticut.

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L. I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

What's happening in MATERIALS

Ceramic adhesives gain strength

Oxide-type bonding agents that show a shear strength of better than 5600 psi at temperatures as high as 800 F . . . that's the latest report from the University of Illinois ceramics laboratory. Result of a long-term project aimed at developing refractory adhesives for structural use, the adhesives are made by combining oxides of silicon, aluminum, zinc and other metals with carbonyl iron and silicon powder.

An indication of the rapid progress already made is the fact that a formal report (WADC Technical Report 55-491), just a year ago, listed the best performance up to that time as barely 2000 psi.

New corrosion problem for titanium

Titanium takes to salt-water like a fish: It is remarkably resistant to corrosion at all normal temperatures; but, above the boiling point, while it doesn't get cooked, it does tend to stress-corrosion cracking.

Says Battelle Memorial Institute: "Recent evidence has established that titanium alloys are subject to stress-corrosion cracking when in intimate contact with sodium chloride at temperatures above 500 F."

So far, no failures of this type have been reported, but at least six companies have experimental or contemplated service applications in the range and under the conditions where this type of cracking may occur.

What to do? Oxide and anodic films and several types of metal coatings can help. Glass-bead blasting is another possibility (for temperatures in the 500 to 700-F range at least). Alloying, too, may solve the problem. But much more remains to be learned about the corrosion-reaction mechanism.

briefs . . .

Metallized paper for everything from labels to insulation will be available commercially as a result of a new combination: Champion Paper & Fibre and National Research Corp., now setting up production facilities.

Acceptance of 200-series stainless steels is spotlighted by Electromet report which notes that, while production of most stainless types dropped sharply in the fourth quarter of 1957, the new 200 series kept right on climbing. Production of this type, incidentally, increased 10-fold from 1955 to 1956 (1900 to 19,500 tons), then went up another 28% (to about 25,000 ingot tons) in 1957.

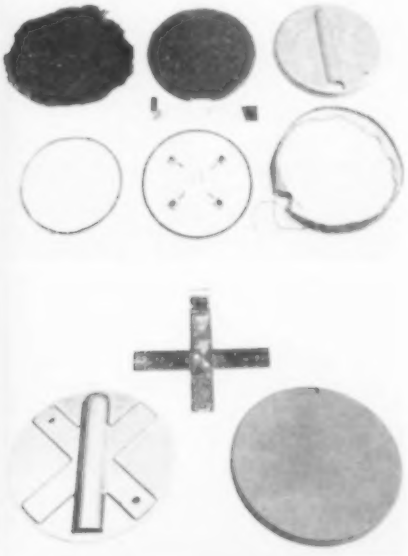
Bright galvanized wire, made in Belgium, is soon to be available here. Said to be "highly desirable for use in wire baskets, hooks, hangers, ties, and other manufactured good which require a bright, shiny finish," it will be sold in ASWG sizes from #000 to #20 gage, at regular galvanized wire prices. Sambre-Escaut of Belgium is making it. Samples and information may be had from M. Paquet & Co., 17 Battery Place, New York 4.

Acrylic laminating resin, said to be first of its type, is being test-marketed by duPont. Initial water-whiteness, resistance to weathering, surface abrasion, and impact damage, and good mechanical properties should bring it a good many applications, ranging from truck and trailer skylights to instrument windows. No date has yet been set for general commercial introduction.

Vinyl combination for design simplification

Eleven parts are reduced to five and costly sewing operations are eliminated at Checker Cab through use of a molded vinyl foam-vinyl plastisol combination for jump seats.

Simplifications like this, long promised, are only now beginning to appear. But, with such advantages as light weight, easy cleaning, and dollar savings in production, foamed plastics apparently have what it takes for instrument cases, panelings, and other parts as well as seating. —A.R.G.



New jump seat is made of Bakelite Company's plastic, costs $5.75 less than standard model. Photos at far right compare old seven-part base (top right) with new three-element one.

Permaglas® water heaters continue to set new, higher standards of life expectancy.

Q

What should a manufacturer do when he has the finest product on the market?

A

Develop a better one, of course!

That's the refreshing idea behind A. O. Smith's NEW KIND OF GLASS-PROT ...Exclusive HYDRASTEEL*

Something new under the blue — born of pace-making research

Giving new dimensions to the world's most useful metal is an A. O. Smith specialty. No other manufacturer has contributed so much to the research and development of glass coatings that guard steel against corrosive and abrasive attack. Result: A. O. Smith products of glass-protected steel have won world-wide recognition for superior quality and lasting dependability.

Now A. O. Smith announces a significant new development — HYDRASTEEL — to create a new kind of glass-protected steel that excels the best ever produced before.

Essentially, HYDRASTEEL is the combination of special treatments that prepare metal to accommodate new, high-performance glasses. These glass formulations developed by A. O. Smith were actually so advanced that there was no existing steel with which they could be used. A. O. Smith research literally *brought the metal up-to-date.*

The promise of this new glass protection can best be measured by the fact that A. O. Smith has increased warranty coverage on 1958 Permaglas HYDRASTEEL water heaters by 50%. This is particularly impressive when you consider the pre-HYDRASTEEL record. In accelerated corrosion tests, conducted by an independent laboratory, no other glass-lined water heater brand approached the corrosion resistance offered by Permaglas.

So, with the finest product on the market, what did A. O. Smith do? Developed a better one, of course.

U. S. Patent No. 2,754,222 and other Patents Pending

Permaglas beer storage tanks, approved by brewers everywhere, guard product flavor, purity and uniformity.

Harvestores*®** for farm feed processing; ***Permaglas mechanized storage units for industrial bulk materials-handling.

Permaglas smokestacks are being hailed as the economical answer to industry's need for longer stack life.

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How we work steel to make steel work for you

Through research A.O. Smith *... a better way*

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... where creative skill with steel serves you through better products and processes for home, farm, industry and government.

A. O. Smith International S.A., Milwaukee 1, Wisconsin, U.S.A.

- A. O. Smith's research in the field of glass-coatings dates from 1928 — over 3,500 specific glass formulations have been developed and tested.
- Result of pace-making research — A. O. Smith is the world's largest manufacturer of glass-protected steel products.
- Write for free, illustrated booklet, THE INSIDE STORY OF GLASS-PROTECTED STEEL.

PRODUCT-DESIGN MEMOS FROM DUREZ

Heavy-duty parts
Making epoxies flame-resistant

Metallized phenolics

Chrysler Corporation

Rugged

Got a job that's "too tough for phenolics"?

You might never think of phenolic for a part like this Chrysler-engineered automotive oil-pump gear–subject to wear, heat, friction, constant oil immersion.

But you'd be reckoning without the ruggedness of a new phenolic, *Durez 16771*.

Parts molded from this glass-fiber-filled compound have a flexural strength of 20,000 psi, compressive strength of 16,500 psi. Their tensile strength is 7,000 psi. Modulus of elasticity in tension is 3.0×10^6 psi. What's more, the heat distortion point of these parts is up around 600° F.

Payoff • These properties, plus excellent resistance to oil, water, and acid, made Durez 16771 appear to have some of the properties needed for the Chrysler oil-pump gear. After extensive experimenting and testing, Chrysler engineers developed the plastic gear to replace the usual metal part.

Results: *new gears of Durez 16771 outwear metal gears nearly 3 to 1–show no performance-affecting wear after 200,000 miles; save about two-thirds of the cost of metal gears; run more quietly.*

For a data sheet describing this high-strength phenolic, check opposite "16771" on the coupon.

How to make epoxies resist flame

Your epoxy laminates and castings will shrug off heat, moisture–even fire–if you cure them with a new Durez product called HET® Anhydride.

In the picture that follows, the laminate cured with a conventional hardener ignites in less than 30 seconds and burns to destruction in about 3 minutes. Exposed to a similar flame source for the same time, a HET-cured laminate snuffs itself out as soon as the flame source is removed.

This leads to some interesting possibilities. For instance, you can now make glass-reinforced laminates that keep practically all their flexural strength, *even when heated within the 300-350° F range.*

You can make potting resins that retain room-temperature electrical properties at high humidities *and at temperatures above 300°F*–and won't feed a fire.

For easier casting or wet layup, you need not handle HET Anhydride hot. You can mix it with another anhydride to form a curing system that *stays liquid at room temperature*. Toxicity is very low.

If you'd like complete information on HET Anhydride, methods of use, and properties of cured resins, check the coupon for Bulletins 19 and 43.

Bright idea

Next time you want to put a bright reflective surface on a part, think of *metallized phenolic*. It may save you a costly production step.

American Optical Company

For instance, this housing for a microscope lamp requires a mirror to focus the light.

To sidestep the cost of a custom-made mirror, the housing is molded of Durez phenolic. Then an aluminum mirror is deposited right on the plastic by vacuum evaporation.

This is easy to do with the Durez compound chosen for this part. It provides a good hard surface for metallizing. It incorporates other wanted properties: high impact strength and low thermal conductivity.

You're on sure ground when you base bright ideas like this on phenolics. They give you a bigger choice of controlled properties than any other material in their class. You can select the right balance from *more than 150 Durez compounds.*

To take a fresh look at today's phenolics, just check the coupon for a new four-page bulletin describing some typical Durez molding compounds and what you can do with them.

For more information on Durez materials mentioned above, check here:

- ☐ High-impact Durez 16771
- ☐ HET Anhydride–Bulletins 19 and 43
- ☐ Phenolic molding compounds–descriptive bulletin

Clip and mail to us with your name, title, company address. *(When requesting samples, please use business letterhead.)*

DUREZ® HOOKER CHEMICALS PLASTICS

PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

1501 Walck Road. North Tonawanda, N. Y.

what will they dream about now?

When some of us were youngsters, we dreamed of aircraft faster than sound, rockets to the moon, atomic power, or pictures sent through the air. We had Jules Verne, Horatio Alger, or more recently, the writers who invented Superman, Buck Rogers and Captain Midnight. These were fantastic, unbelievable stories, even though there was scientific fact as a basis. They fired our imagination, suggested a perilous future safely distant "in the 25th Century." Many a boy began to study mathematics, physics, science, engineering, because of these dreams, because he might make those dreams come true.

Interestingly enough, Lucian talked about space flight in 160 A.D. ("True History"), Cyrano de Bergerac suggested rockets for moon travel in 1649, Edward Everett Hale talked of satellites for geophysical purposes in an *Atlantic Monthly* serial in 1870 ("The Brick Moon"), and Jules Verne described the Nautilus the same year.

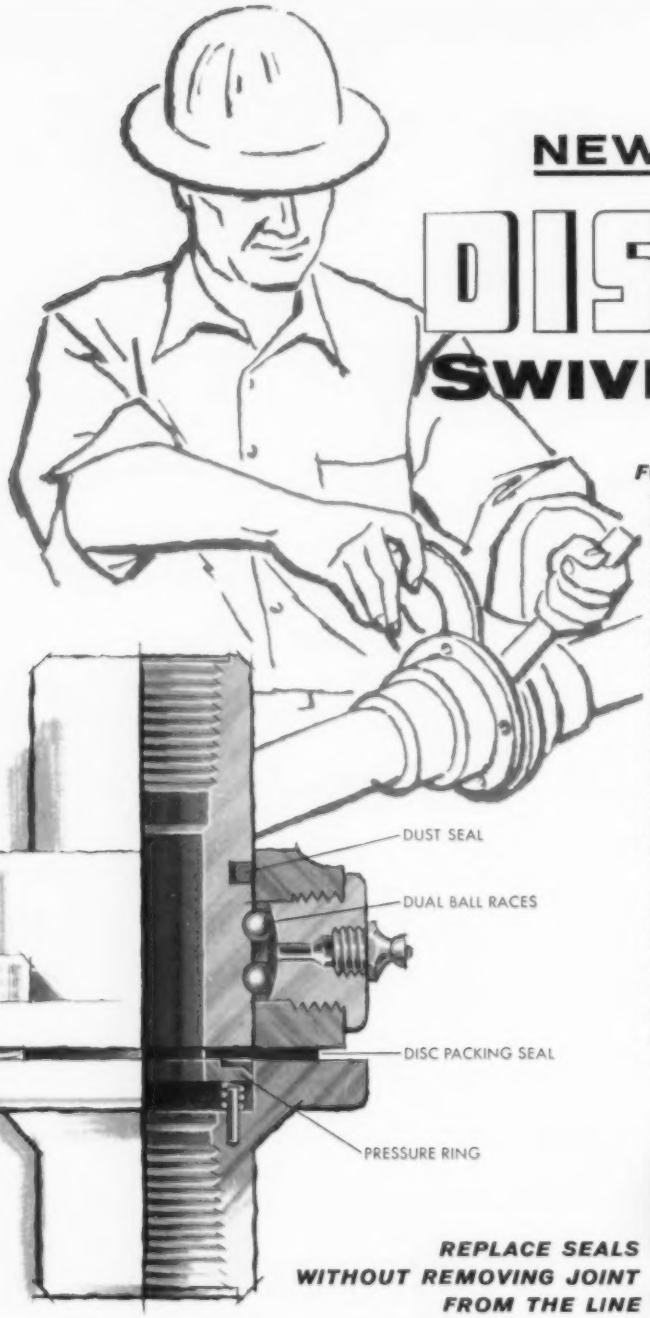
Now most of those dreams have come true—or almost. We've telescoped the centuries, so our future is here with us now. Somewhere along the line, we oldsters have stopped dreaming, because we've made our dreams almost too true to life.

But the current crop of science fiction is different. Yesterday's science had been extrapolated so often, and in so many different directions, that even the wildest dreams became cliches.

So—what's left for the dreamers? What still seems, today, to be utterly impossible—interstellar travel (shortest trip: 25 trillion miles), the "space ark" (with a crew that perpetuates itself, generation by generation, as it travels), time travel, or time foreshortening.

But most of the writers skip over the physical details and the physical sciences. Now the non-physical sciences are getting the play—probably because they are far from precise at present, yet offer the most promise. Sociology, anthropology and psychology are only just beginning to attain the predictive, repetitive accuracy necessary to earn the dignity of what we term a science. Many areas here are still speculative, but these sciences may well do for civilization as much or more than atomic power or space flight.

And so science-fiction writers (and our sons) explore the human mind, the rise and fall of civilizations, interpersonal relationships, the so-called "psi powers" (telepathy, teleportation, extra-sensory perception and the like). And if science fiction continues to be as prophetic as it has been, our children won't be engineers, they'll be psychiatrists, social analysts and better husbands, fathers, and *world* citizens than their fathers ever hoped to be.



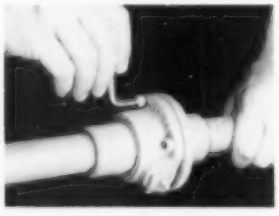
REPLACE SEALS WITHOUT REMOVING JOINT FROM THE LINE

NEW CHIKSAN DISCPAK SWIVEL JOINTS

FOR STEAM AND HOT GAS SERVICE

Created specifically for service on lines employed in steam and hot gas service, the Chiksan Discpak embodies a new construction design which permits packing units to be replaced without removing the joint from the line. The outer housing of the Discpak is cut apart at the packing chamber and both ends are flanged at the cut. Four allen-type cap screw bolts are used to secure the flanges. A disc-seal, housed between the two members, provides a fluid-tight seal between rotating and stationary members of the Discpak Swivel Joint. A spring loaded pressure plate holds the packing in sealing position against the swiveling member.

The new Discpak has a maximum temperature rating of 600° F. and a maximum pressure rating of 300 psi. All turning movement in the Discpak takes place on a double row of precision ball bearings. Write today for literature and prices. If your plant or equipment lines utilize hot gas or steam, it will pay you to know about this new field-proven Discpak swivel joint.



To replace the disc-seal, simply remove four allen screws and spread line slightly with a flat metal bar.

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New Discpak Bulletin 100 describes in detail the many features of this new swivel joint including full mechanical specifications.

57-26

Red Tape Worm in the Desert

CHINA LAKE, CALIF.—All is not well here at the Naval Ordnance Test Station, development home of the Sidewinder missile and located amidst the sands of a West Coast desert.

Scientists here are dedicated to ordnance R&D. Despite a maze of red tape and objectionable policy decisions that filter through from Washington, they accomplish their work with inordinate success.

Yet they report to PRODUCT ENGINEERING that they work far more effectively as a small, well-integrated group unhampered by clogging bureaucracy and slender budgets. They feel missile development would move faster if conducted as government rather than as industry projects. As Dr. H. A. Wilcox, head of NOTS weapons development says:

"I feel that our real failure is the result of putting all missile R&D under the control of industry. Proof of the pudding is the fact that to date the US under our present management system (industry control of R&D) is not well-geared to produce good, reliable, maintenance-free ordnance, nor any other kind of military equipment.

"The record is that our airplanes have been generally inferior; our guns and tanks could not match—unit for unit—corresponding German equipment during WW II. The fact is that our airplanes are not well designed, just as our cars, our TV sets, our children's toys are poorly designed. Our tooling is geared to mass production, our commercial products designed to sell quickly and wear out faster."

From a step higher comes the considered opinion of William B. McLean, technical director of NOTS: "Our ideal function is to serve as technical go-between for Washington and industry. The latter is trying to remedy its development situation by hiring retired military men. But in the area of military equipment, industry is suited best to produce what has already been developed.

"The effective development of missiles and other complicated equipment," McLean says, "requires a small, well-integrated group rather than thousands of specialists. Peenemunde and war-time Los Alamos are good positive examples of this approach."

Bureaucratic cost-accounting policies also restrict the station's performance. Says McLean: "We could double the output of this station if we didn't have to wait on petty money transactions. We have to cut back R&D while we account for the use of gasoline, public works, travel, and even telephone expenses. We lose more than we save.

"Before the Sputniks, we were told we would have to reduce expenditures by 10%, and this was while we were working in new fields, not knowing what we'd need, nor what it would cost us," McLean explains.

Another irritant at China Lake is the matter of need-to-know clearance procedures. McLean's opinion: "Basically silly."

"How can someone at a desk in Washington know whether someone at China Lake should have authorization to attend a meeting?" he asks. McLean also cited the case recently of a department head in need of management training. McLean sought approval from the Office of the Secretary of the Navy to send the man to training school. The request was denied. Countless other acts have impeded smooth flow of management processes.

Dr. Gilbert Plain, associate research department head at NOTS, recalls sitting across the desk from another scientist, unable to discuss matters of mutual awareness because clearance to talk had not arrived from Washington. On another occasion, an MIT professor couldn't show Dr. Plain a classified side of the Brookhaven reactor because Dr. Plain's clearance had not arrived.

R. W. Herman, head of the data-automation branch at NOTS, reports: "I have missed at least four or five meetings I should have attended last year, simply because of the six-week delay in getting approval to attend."

This delay is a prime factor in keeping China Lake restive. The men at NOTS use term "Washington complex," to describe the miasma of channels that slows up response to requests:

Smith cites the example of submarine commander who said his critical need was for a 60-knot torpedo with a range of 20,000 yd. Why? So his sub could stand off at a safe distance and torpedo a carrier. It didn't occur to the sub commander that carriers are not used in navies of enemy countries throughout the world.

"We need people working for a profit," says Bernard Smith, head of the NOTS central staff. "The place

NOTS' chief claim to fame is development of the Sidewinder air-to-air missile, least expensive of all US missiles to develop, and so far, most accurate. Sidewinder does not require a special aircraft as carrier, may be mounted on any aircraft. Significantly, it was developed without detailed specifications from Washington. NOTS worked under its own headings.

Its unqualified successs is even more apparent when comparing cost figures for other US missiles: Sperry developed Sparrow I for $500 million; Raytheon charged $50 million for Sparrow III; Bell Telephone, Douglas and others developed Nike for $7 billion and Hughes developed Falcon for $500 million according to NOTS. Sidewinder as developed by NOTS cost $35 million.

for American industry is in building according to production contracts. In high-risk development work, the taxpayer needs control over how his money is spent.

Smith cites the example of submarine commander who said his critical need was for a 60-knot torpedo with a range of 20,000 yd. Why? So his sub could stand off at a safe distance and torpedo a carrier. It didn't occur to the sub commander that none of our potential enemies use carriers.

Control is and should be exerted by Congress, Smith believes. High-risk contracts let to industry must be filled with best-effort clauses. They are loaded with temptations, through no fault of industry.

"There should be no conflict of interest between government and industry if they both cooperate while attending to their own proper knitting; industry to production, and government scientists to weapons development," Smith says.

Another source of friction is the government-industry cost-plus-fee method of developing. NOTS personnel says it boosts costs and frequently produces items that don't jibe with reality. In addition, the CPFF system creates an undesirable bidding situation, and discourages some highly capable companies from competing for contracts.

Solution: Unfettered research and development can best be accomplished in government-operated centers such as China Lake and Redstone Arsenal rather than within private industry.

The difficulties so far mentioned apply equally to China Lake and other installations. But China Lake has had more than just policy troubles. Until three years ago a knock-down, drag-out feud raged between station personnel and merchants of the community adjoining China Lake–Ridgecrest.

Focal point of the controversy was the China Lake commissary, to which Ridgecrest merchants took violent exception, claiming commissary prices were taking away their business. Also, a fence that enclosed the station served a psychological as well as physical barrier between the two groups.

The station complement resented the limitation of social life in the desert area. And the townspeople didn't feel the China Lake folks were pulling their weight in the matter of taxes. There were squabbles over schools, over property rights for a missile test area and a myriad of other minor irritations.

But gradually relations have improved. Much of the credit goes to men like McLean, who work tirelessly to ease tensions, promote good will. In addition, a program of explanatory lectures accompanied by a full-blown local public-relations program has been set underway. Though some tension remains, most of Ridgecrest's 5000 population feels friendlier toward the China Lake operation, which numbers some 10,000 people.

All that remains (and it's considerable) is for the Pentagon to shift its R&D thinking, giving the development responsibility back to the nonprofit experts and turning over complete production authority to industry.

Give R&D back . . .

. . . to government scientists is plea of China Lake administrators (left photo) L-R: H. G. Wilson, associate technical director; Dr. William B. McLean, NOTS technical director; and Dr. H. A. Wilcox, weapons development department head. Variable-angle launcher, next photo, blows projectiles into water with compressed air. Living quarters of the NOTS China Lake station, in California desert are cramped but adequate. In photo at right are Dr. McLean at left, Ernest George, information specialist (McLean says he could use three more PIOs to win over local townspeople), and William W. Hollister, station commandant. Station population is 10,000.

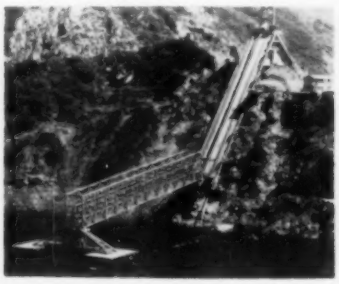
Compact computing . . . is all contained in standard desk. Key-entry unit uses conventional calculator-type keyboard to "feed" system, program calculations. Flush with desk top, 14-digit printer lowers into top drawer when opened. Lower drawer holds electronic arithmetic computation unit, magnetic drum memory. System, developed by Clary Corp., has self-check capability.

Automated Line Speeds GE Motor Manufacture

SCHENECTADY, N. Y.—General Electric's new automated factory was opened here recently for the high-speed production of its Tri-Clad 55 a-c 40-125 hp motors.

Key to the increased production cycle is the flexible design of these motors which permits the company to build and stock 80% of the parts for all motors, both standard and special. Less than one-third of the motors in this hp rating are standards; the rest are specials.

The factory has been separated into two independent areas: component parts and assembly. Machining for all three frame sizes, 360, 400 and 440 is performed by three automatic machines, replacing seven formerly used for the same operation.



1959 Budget: Military, Science Get More

President Eisenhower has presented Congress with the biggest peacetime budget in history, a record breaking $73.9 billion. In doing so, he told the legislators, "I feel confident that this budget expresses the way in which the American people will want to respond to the promises and dangers of the dawning age of space conquest."

But, the budget drew sharp criticism from many lawmakers. Some blasted it as being too conservative in its approach to the missiles race with Russia. Others, took the opposite view, termed it too big in face of today's economic conditions. Such comments came from Arch Conservative Senator Harry F. Byrd (D-Va.) who said, "I call the new fiscal program for the coming year reckless. It is likely to lead to substantial deficit spending with all of its evil consequences."

As presented, however, here is how the $73.9 billion would be spent: (see Tables for detailed breakdown) 64% goes for Defense–Military Programs, R & D, Atomic Energy Programs, Stockpiling for Defense, and Military Mutual Security Programs. The military programs get $39.7 billion, compared with this year's estimated $38.8 billion.

Atomic Energy Programs are slated to spend $2.5 billion next year, compared with $2.3 billion this year, and $1.9 billion spent in 1957. Stockpiling and Defense Production Programs will spend $422 million under the proposed budget, compared with $565 million expected to be spent this year and $490 million which were spent in 1957.

Spending for Mutual Security Programs will amount to $3.0 billion in 1959, compared with $3.1 billion this year and $3.4 billion which were spent in 1957.

Shift in Emphasis

As the Administration moves into its first space-age budget year, it is shifting emphasis in weaponry:

- Manned aircraft production – in terms of shipments, new orders, and new appropriations–is falling sharply.
- Development and production of long-range ballistic missiles is accelerated. So is work on ballistic missile detection and defense systems, and missile-armed atomic submarine construction.
- Development of outer space projects–reconnaissance satellites, rocket engines, and the like–is being pushed faster. At the same time, basic research efforts in this field are being stepped up.
- Production of "conventional" weapons–combat vehicles, ammunition, small arms, and such–is slowed down some more. But, for the first time in five years, Army, is asking for new funds ($1.4-billion) for hardware. Up to now, it has lived on unspent Korean War appropriations.
- Procurement of production equipment and facilities is dropping to the lowest level since pre-Korea.

More for Technical Information

On the nonmilitary side of the budget, more money is slated for programs to get technical information–both foreign and domestic–into wider industrial circulation. In the post-Sputnik era, this has been pointed out as a weak link in the US Technical Information program.

The National Science Foundation is due to get close to $1.1 million–about three times its current budget–for translating foreign scientific information. Virtually all of this money goes for translating Russian technical journals.

The Business and Defense Services Administration of the Commerce Department is slated for a $1.3 million increase in its Technical Information Service. The bulk of this is to be used to set up a translation center and a clearinghouse for foreign scientific information. Documents are to be available to industry on a fee basis. As an indication of the importance the Administration puts on this program, it is going to ask for a supplemental appropriation within the next few weeks to get the project started.

The National Advisory Committee for Aeronautics, charged specifically with providing scientific and engineering data for improvements in design and performance of aircraft, missiles, and powerplants, is due to get $80.4 million–a $10 million increase of the current budget. Biggest increases will go in the fields of aerodynamic research–a $4.5 million increase over its present $38 million budget; powerplant research, up $2.8 million over the current $16.4 million budget; and aircraft structural research–up $1.4 million over its present $8.7 million budget.

More for Missiles

Missile spending will rise $1 billion in 1959. Estimates are that expenditures, covering production and procurement, research and development, guided missile ship construction, and missile-related construction will come close to $5.3 billion next year. Currently this spending is running around $4.3 billion.

Nearly half of next year's missile budget is for long range ballistic missiles. It is earmarked for production of the Thor and Jupiter IRBMS, development of the Polaris IRBM and Atlas and Titan ICBMS, and research on advanced models of these missiles.

In all, estimates are that three-fourths of the military hardware funds in the new budget will go for equipment which "had not been developed in fiscal year 1955 or was not being bought in production quantities that year."

Is It Enough?

But there are many in Washington, and elsewhere, who doubt that the budget and the Administration's plans represent thinking big enough to cope with the Russian threat and the dawning age of space. They feel that the program should be expanded.

The new defense situation puts the scientist and engineer in the limelight as he has never been before. The success of the Russian Sputniks eliminated all doubt that their scientists are as advanced and capable as ours. It now becomes a question of providing leadership, money and an organization to produce equivalent US results.

For the first time, the President of the United States has on his staff a personal advisor on science and technology–Dr. James Killian, President of MIT now on leave. Killian hopes he won't have to appear before Congress; but the policies he recommends to the Administration will be under the closest scrutiny.

Table I—Spending for the Age of Space

	This Year (FY 1958) (Billions of Dollars)	Next Year (FY 1959) (Billions of Dollars)
Space Science and Space Weapons		
Spending Total	2.3	2.7
Appropriation Total	2.0	3.0
Ballistic-Missiles Production		
Spending	1.4	1.7
Appropriation	1.3	1.9
Research—Basic, Satellites, Rocket Engines		
Spending	0.9	1.0
Appropriation	0.7	1.1
Air, Sea, Land Weapon Production		
Spending Total	12.0	12.0
Appropriation Total	10.1	11.5
Aircraft		
Spending	7.5	6.9
Appropriation	5.7	5.8
Ships		
Spending	1.1	1.3
Appropriation	1.7	1.3
Tactical and Anti-Aircraft Missiles		
Spending	1.5	1.6
Appropriation	1.6	1.9
Army Weapons	(Millions of Dollars)	
Spending	156	98
Appropriation	None	184
Science Education		
Spending Total	17	122
Appropriation Total	60	228
Scholarships and Other Aids		
Spending	None	75
Appropriation	None	146
Research Grants		
Spending	17	53
Appropriation	60	82

Table II—Scientific Research and Development

	This Year (FY 1958) (Millions)	Next Year (FY 1959) (Millions)
All Federal Programs	$3,426.5	$3,721.8
Military Programs	1,810.7	2,211.0
Aircraft and Equipment	272.4	245.8
Guided Missiles	432.0	513.7
Ships and Small Craft	80.7	97.0
Combat and Support Vehicles	16.8	16.2
Artillery and Other Weapons	16.7	14.7
Ammunition and Equipment	80.4	85.5
Military Sciences	246.0	250.1
Operation of Facilities	390.0	403.2
Advanced Research Projects Agency	10.0	300.0
Other Equipment, Special Accounts, etc.	265.7	284.1
Atomic Energy Commission R&D		
Total Spending	655.5	697.9
Production and Weapons	130.6	120.4
Reactor Development	378.9	424.7
Physical Research	81.5	85.0
Biology and Medicine	40.7	42.7
National Advisory Committee for Aeronautics		
Total Spending	94.0	100.5
Airways Modernization Board		
Total Spending	5.7	28.0

How Does Your Reading Rate?

NEW YORK—How do engineer reading skills match those of nontechnically trained readers? To find out, GE tested the reading speed (words per min) of a group of electrical engineers and their wives and children.

Results showed that engineer reading speed averaged 220 wpm compared with 418 wpm for wives and children. Surprisingly, in reading about the fairly technical geology, engineers averaged 70 wpm slower than the other test groups. Significantly, this and other recent reading tests indicate that most professionally trained executives read at a speed of about 200-300 wpm—less than a sixth-grader.

Executives build reading speeds . . .
with help of "pacer," adjustable to cover text line by line at speeds up to 3000 wpm.

"Skillful reading," says William S. Schaill, president of The Reading Laboratory, Inc., "must be learned." He explains that engineers and other professional groups can be taught to raise their reading ability to an average of 400-500 wpm with 60-80% comprehension, by proper reading techniques, and by self-discipline.

Basic instruction equipment, according to the specialists, is the tachistoscope, or "flash meter," the "pacer," and training films. The tachistoscope briefly flashes numbers, words and phrases before the trainee, training eye to accurately and quickly absorb words and word-groups from the page. The pacer progressively moves a covering plate down a page of printed material, forcing the reader to keep ahead of it. Where films are used, a

(continued on p. 28)

Old-fashioned filing systems waste time and money; may damage irreplaceable drawings.

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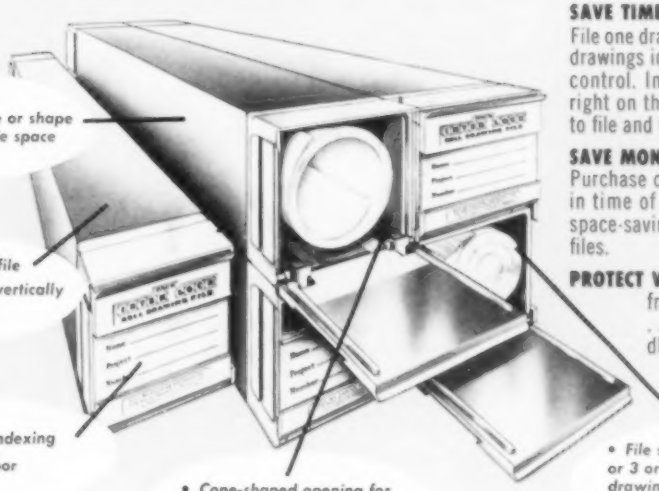

- *Arrange in any size or shape stack to fit available space*
- *Add individual file tubes horizontally or vertically as needed*
- *Individual indexing on file door*
- *Cone-shaped opening for fingertip removal of drawings*
- *File single rolled drawing, or 3 or 4 individually rolled drawings, or group-roll up to 30 per tube*

SAVE SPACE
File up to 3,000 drawings in a 25" x 25" space by group-rolling, if space is a problem. Arrange in any size or shape stack to fit existing space.

SAVE TIME
File one drawing or up to four related drawings in each tube for maximum control. Indexing and out-marking right on the file door makes it easy to file and find needed drawings.

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from dust, crushing and fire . . . and from excess handling damage.

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printed page is flashed on a screen, but the student is permitted to read only according to a fixed pattern—to develop proper eye movement habits.

Backstopping these devices are a wide range of recently marketed study books, special material and equipment. The Reading Laboratory now offers an interest stimulating book that the student can use on his own a few minutes each day. It includes a graph to record reading progress, and a conversion table for timed self-administered reading exercises.

The firm also has a new program for small student groups (7-8 people) in industry, designed to be completed in 10 hr of training. It is administered by a company-designated "leader" who works from a special instruction manual and is furnished teaching aids (student manuals, progress charts, report sheets, and questionnaires) by the Laboratory staff in New York.

How valuable is improved executive reading efficiency? Some GE engineers, by doubling reading speed and improving comprehension, have added one to two hours to their average working day. According to another industry leader, valuable business time saved through improved executive reading skill has added one extra executive for every seven who took it.

The facts of reading:

Eye motion: In scanning a printed page the eye can "see" only when it pauses. The fewer the number of stops needed to cover a line, and the fewer re-readings, the better reader.

Speed: Speed is not the end goal in reading training. The person who can read rapidly, however, is able to slow down when different materials, interests require a moderate pace.

Comprehension: Good comprehension is vital, but 100% comprehension is not necessarily good nor obtainable. Comprehension usually increases when speed builds up.

Concentration: A key factor in better reading habits. Paying close attention to subject matter allows increases in speed, comprehension.

Vocabulary: Reading training usually includes vocabulary. A restricted vocabulary limits reading speed.

Speed Adjustment: Change-of-pace is the mark of a good reader. Adjusting speed to level of material at hand should be sought. Untrained technical people skim, read at same speed.

Motor Keyed to Machine Tool Drives

MILWAUKEE—A motor with a dial speed control delivering constant torque from 50 to 1500 rpm and constant hp from 1500 to 6000 rpm has been developed as the first of a series by Allis-Chalmers for application to machine tool drives.

The initial unit—industry's first water-cooled, shell-type, 10 hp, dc spindle motor, complete with job designed control—was successfully applied to an Ekstrom, Carlson 3-dimensional profile milling machine during a recent demonstration for the press.

Infinite speed variation in the range below base speed results from variation of armature voltage, while adjustment of motor fields voltage permits speed variation in the range above base speed.

The motor's compact design and minimum weight are achieved through Class B insulation and water cooling, the outer frame serving as a supporting structure as well as the outside shell of the water jacket. Inner shell is the magnetic yoke of the dc motor. Internal heat from armature and the field coils is transmitted by conduction through pole pieces and is carried by moving internal air to the magnetic yoke, passing to coolant.

Lubrication for motor's ball bearings is provided by a low pressure oil mist system, seals keeping the oil from entering machine.

Speed of the motor is varied from 50 to 1500 rpm with thyratron armature control, and from 1500 to 6000 rpm by magnetic amplifier field weakening control. An automatic static adjustable-timed acceleration control accelerates the motor at any preset speed, and provides overload protection, field loss protection, IR compensation, overvoltage protection and dynamic breaking.

OEEC Reports on Engineer Shortage

PARIS—The OEEC (Organization for European Economic Cooperation) has strongly urged its members to assess the technical areas in their countries where shortages of scientists and engineers have become an "obstacle to economic progress" or may become so in ten years.

Identification of critical areas can guide educators in overhauling the university and technical-school structure to adapt them to the demands of modern economies.

The recommendations for government and educational action, which followed a country-by-country survey, were presented in a report, "The Problem of Scientific and Technical Manpower in Western Europe, Canada and the United States." The survey indicated all these nations were handicapped by acute shortages.

Shortages were reported in all professional categories—pure, applied, and agricultural sciences—though less with the latter.

OEEC believes immediate action is required if the Western nations are to remain in the vanguard of industrial technical development. Practical industrial experience is incapable of giving men and women the background they need to make technical advances today. A tough education is needed. And, the OEEC observes, too many potentially capable people in all member countries are bypassed through chance economic or social circumstances. This is a serious loss—only a limited number of people in any country can grasp the complexities of advanced science.

Industry has responsibilities too. It should: make certain that trained personnel are relieved of routine tasks; consider wider use of women; ensure adequate remuneration of technical personnel; and encourage advanced training.

The OEEC was founded in 1948 to foster cooperative action among European nations to promote their common economic welfare. Its membership includes 17 western European nations. The US and Canada, though not members, participate in its work, seeking to foster its progress.

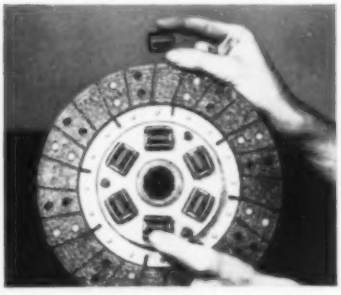
News about NEOPRENE

14 years' experience proves NEOPRENE blocks promote clutch-plate efficiency

For over fourteen years, taxi and truck fleets have been road-testing a new type of replacement clutch plate—one in which resilient blocks of neoprene have replaced conventional metal springs. Results indicate a vast improvement in over-all clutch performance, and maintenance costs have been reduced nearly 50%.

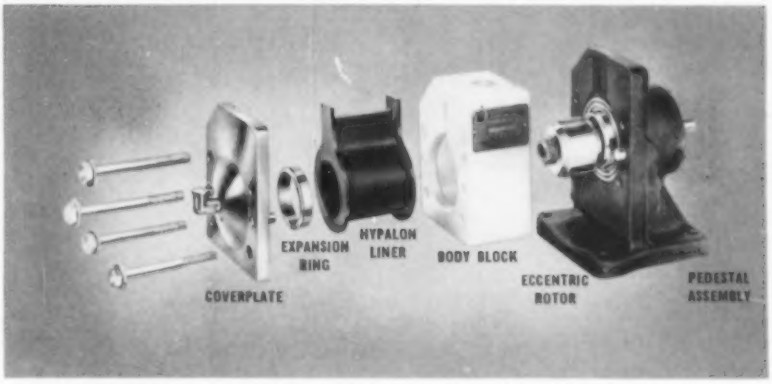
In operation, the neoprene blocks smoothly transmit the torsional force of the clutch. They retain their elasticity for longer than the life of the clutch facing, despite constant flexing and exposure to heat and oil. And cab drivers report there's less lost motion in the drive line—no clutch "chatter"; no trouble with springs breaking or coming loose. The result is more efficient clutch operation and reduced abuse of clutch facings.

It's an outstanding example of design improvement made possible with neoprene, Du Pont's synthetic rubber. Why not see how you can use Du Pont's neoprene to help solve *your* problems? Just clip the coupon for full information.



Small as they are, these neoprene blocks do a big job as replacements for conventional metal springs. Clutch operation is smoother, quieter, more efficient.

Pump lining of HYPALON® withstands 30% HCl for 9 months without damage



Eccentric revolving inside the liner of HYPALON forces acid through pump from inlet to discharge.

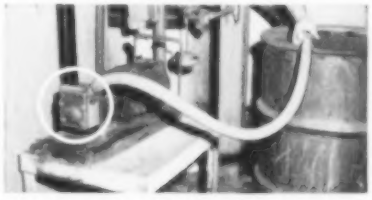
New pump design ended acid leakage; required no maintenance in service

A small rotary pump with a flexible liner of HYPALON synthetic rubber solved a leakage problem for Hoffman-LaRoche, Inc., at its Nutley, N. J., pharmaceutical plant. The pump, used daily to transfer 30% HCl from drums to a measuring tank, is self-priming, leakproof and self-lubricating. It was installed after a succession of other pumps either failed at the packing gland, or couldn't be primed properly. When an equipment change eliminated need for the flexible liner pump, it had operated 9 months with no maintenance whatsoever. Because of this good service, Hoffman-LaRoche engineers plan installation of these pumps at other locations.

Key to the pump's success is its novel design. The tubular liner is flanged and clamped to the exterior of the molded plastic pump housing by end plates. All fluid pumped is trapped between the outside surface of the liner and the pump housing interior, eliminating shaft seals and packing glands. Inside the flexible liner of HYPALON a rotor, eccentrically mounted on the pump shaft, continuously rolls the liquid from inlet to discharge.

The combination of constant flexing and acid attack to which this pump liner was exposed had no effect upon HYPALON. This Du Pont synthetic rubber is made to perform where conditions are severe. For example, HYPALON is completely resistant to ozone, and shows unusual resistance to high (250°-350°F.) temperatures. It is also highly resistant to strong oxidizing agents and weather. For full details on the many properties and design possibilities of HYPALON, just mail coupon below.

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*



Flexible liner of HYPALON prevents leakage . . . eliminate stuffing boxes, shaft seals and check valves.

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Tubeless Aircraft Tire Eyed by Automakers

NEW YORK—A tubeless safety tire, being adapted to aircraft to lessen danger of collapse under tremendous landing impact, may have application to the automobile industry. Tire was invented by Nelson J. Waterbury, here; patent is pending.

Waterbury's tire operates on an entirely new principle that makes it useful for aircraft, either civilian or military. The tire has a vertical inner wall that seals to the rim of the wheel between the two outer walls and is also sealed to the inside surface of the tire. The effect is that of two separate tires mounted side by side, each separately inflated through its own valve.

It is this vertical inner wall that makes Waterbury's tire applicable to airplanes. The wall lends extra stiffness to the tire and greatly increases its resistance to flattening under sudden compression, as in a plane's landing.

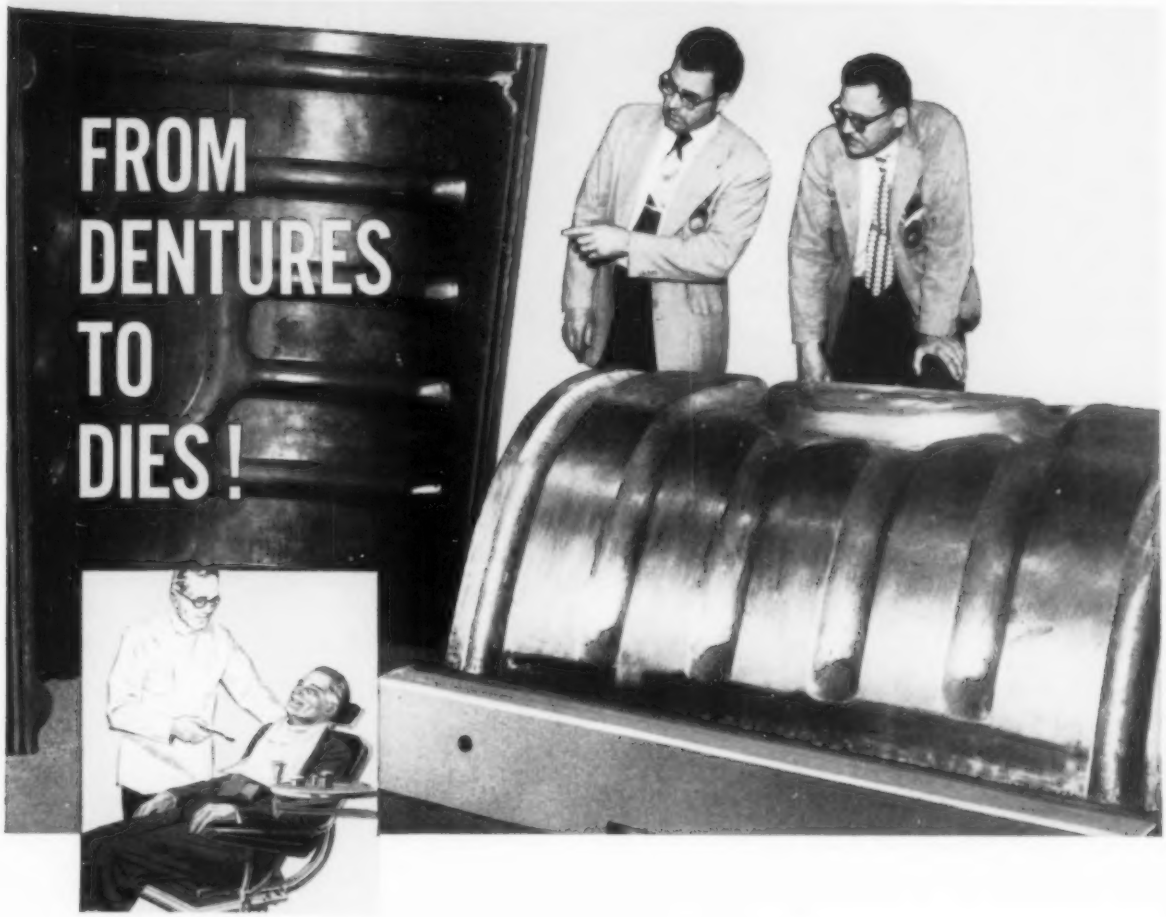
The result is increased protection against blowout. And if a blowout should occur in one chamber, the vehicle, whether automobile or plane, is not endangered, because the other chamber has sufficient strength and balance to bear the weight without collapsing. And the vehicle does not drop suddenly so there is no danger of sudden and dangerous veering.

Another Soviet First?

BONN—A Russian professor, writing in a German-language magazine, claims that the first scientific program for space flights using liquid-fuel rockets was developed as early as 1903 by the Russian scientist, Ziolkowski. Prof. Pokrowski said also that the first theoretical calculation of a multiphase rocket was in 1929 by Ziolkowski.

Japan to Revive Institute

TOKYO—Tokyo University may revive its wartime Aircraft Research Institute through reorganization of its present Research Institute of Science and Technology. The projected institute would mobilize former members and facilities of occupation-banned research setup for study of aeronautics.



Molding compounds made with Thiokol liquid polymers give accurate reproduction, are inexpensive and easy to use

NEW plastic molding compounds made of epoxy resin and THIOKOL liquid polymers are being used throughout industry to improve quality and cut costs.

One of the most interesting applications is in the production of low cost plastic dies which not only provide remarkably faithful reproduction, but also make possible substantial savings in tooling costs. The parts pressed from such dies are accurate in every detail, and require no additional grinding, buffing or finishing. Easily cast and cured at room temperature with no harmful shrinkage, these resilient dies possess great impact resistance, and are virtually unaffected by solvents, oils, acids and alkalis.

Where intricate, extremely accurate, and flexible molds are required, THIOKOL liquid polymers are used as the base, with fillers added to provide the tensile and modulus strength desired. Compounds of this nature are used in the preparation of dental plates, reproductions of topographic maps, and other detailed reproductions. The dimensional stability and room temperature curing properties, and easy handling of these polymers make them ideal for a wide variety of applications.

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FOR MORE INFORMATION, mail coupon to Dept. 41, Thiokol Chemical Corporation, 780 N. Clinton Avenue, Trenton 7, New Jersey. In Canada: Naugatuck Chemicals Division, Dominion Rubber Company, Elmira, Ontario.

Gentlemen: Please send me further details about plastic molding compounds based on Thiokol liquid polymers.

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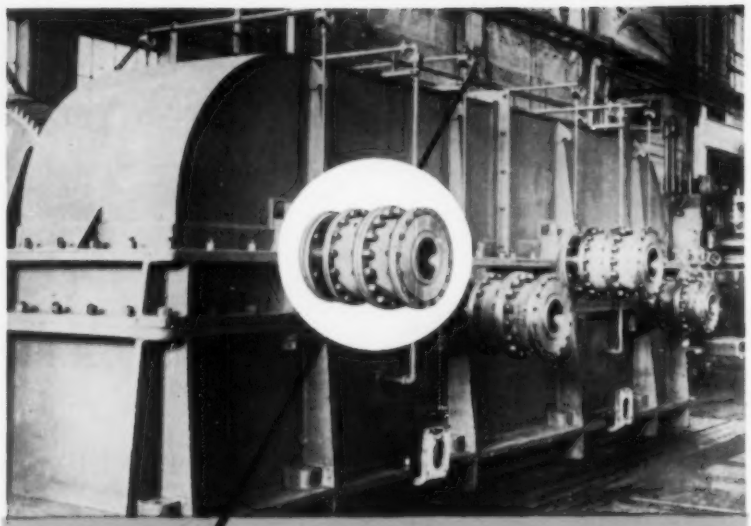

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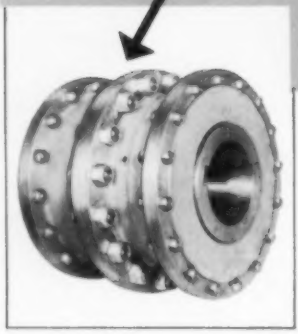

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USSR Scientists Foresee Bigger, Breakthroughs

BONN—The Russian space researcher, Dobronrawow, believes that new, bigger and more perfect satellites will be launched by the USSR in 1958, including satellites that will return to earth. This and other predictions made by Soviet scientists were published in the East German paper, Neus Deutschland.

The head of the Russian antarctic expedition, Prof. Somow, predicts that the so-called inaccessible place in the antarctic region will be reached this year. This would make possible precise information on the dynamic antarctic cold-air flow that influences the climate on the southern and northern hemispheres. The physicist Ginsberg expects important progress in the control of thermonuclear proceedings.

Navy Book Tells How to Track Missiles

WASHINGTON—The Navy has just released a booklet telling amateur radio hams how to track the Vanguard earth satellite. The booklet describes two systems that can be set up at little cost—one merely records the passage of the satellite; the other, more complicated, enables the operator to collect data of value to the Navy.

The booklet titled simply, "PB 131330, Project Vanguard Report No. 21, Minitrack Report No. 2—the Mark II Minitrack System," is available at the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Cost is $1.

French Seek US A-sub

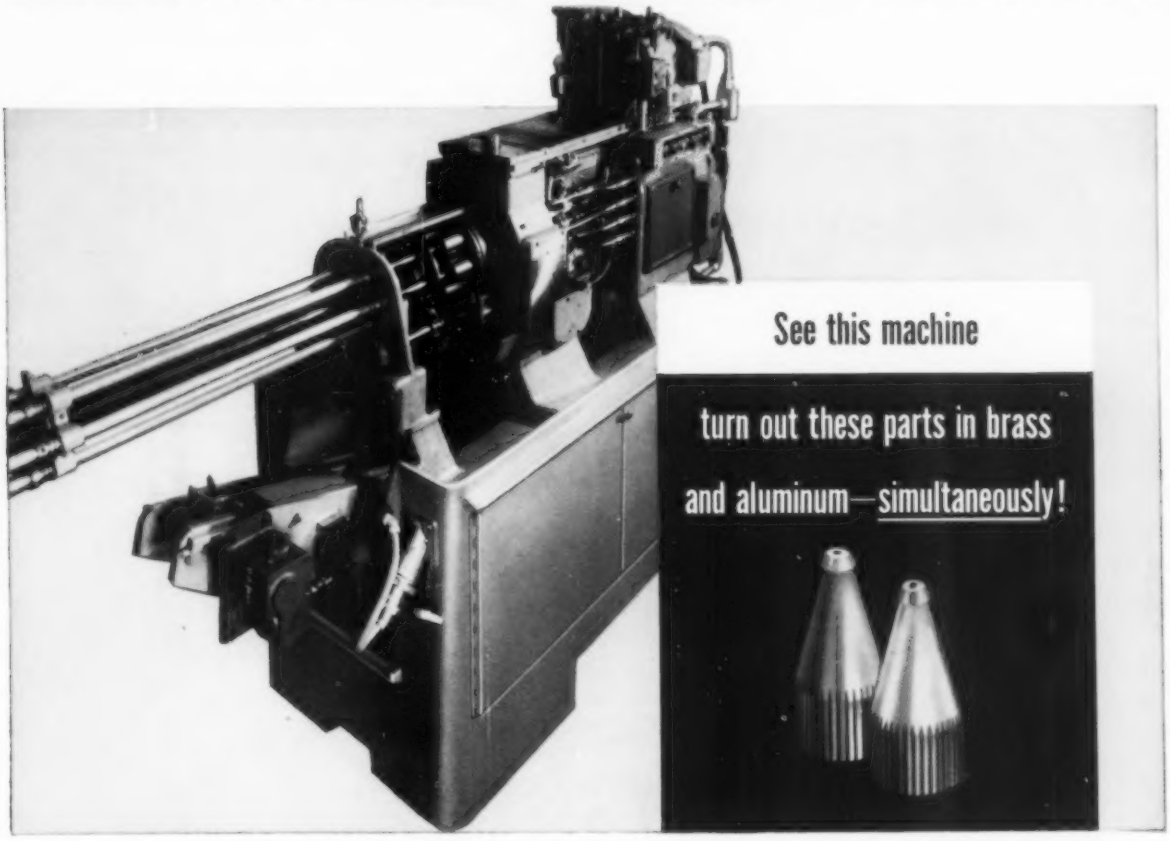
PARIS—France will discuss a US offer of plans for an atomic submarine soon in direct negotiations with the US, a government spokesman said.

The US offer was recently made by Secretary of State Dulles in behalf of Pres. Eisenhower to all North Atlantic Treaty Alliance members.

The American offer is under study here, the French spokesman stated. It was indicated that approval is assured because of French desire to revitalize naval facilities.

BETTER MACHINING STARTS WITH ALCOA SCREW MACHINE STOCK

Alcoa proved it in Cleveland . . . now will prove it in other cities



See screw machine parts produced in aluminum at less cost than steel or brass

When Alcoa and National Acme Company sponsored a machining demonstration in Cleveland last September, 700 design and production engineers and purchasing people saw aluminum and brass parts produced *simultaneously* on a six-spindle automatic screw machine—saw documented evidence that screw machine parts can be produced cheaper in aluminum than in brass or steel. Many expressed frank amazement at the cost comparisons shown.

Here is eye-opening machining news for all industry. Now *you* can see this demonstration, which Alcoa will sponsor in Chicago,* Boston, New York, Detroit, Los Angeles and other important centers.

If your function is design or production of products that use screw machine parts, you will find the Alcoa machining demonstration an enlightening experience. You will see how aluminum offers the ultimate in design freedom because it's so workable, so easy to machine—because it gives better finishes including anodized color. You will see the new color movie about Alcoa Screw Machine Stock, "The Four Amazing Alloys."

Send in the coupon for your invitation—and for a Design Calculator (slip-stick) for use with Alcoa® Aluminum Screw Machine Stock.

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SO YOU WANT TO WORK ABROAD!

Exotic places are magnetic and the jobs they offer may sound romantic, but remember, the standard of living is very different and possibly much less comfortable—no matter how high the salary

BENEDICT A. LEERBURGER, JR.
Assistant Editor

DO'S —

Secure a contract (if possible).
Have a tax attorney explain your future tax setup.
Check with your local election board for an absentee ballot.
Have the State Department explain how to retain your US citizenship.
Study the language.

DON'TS —

Quit your job without another job waiting for you.
Expect foreign organizational setup or way of business to be similar to ours.
Turn up your nose at the engineering organizations you'll find abroad.
Lord it over your new working associates with unnecessary display of your standard of living.

You're sick of daily desk routine. Looking out the window, you daydream. And sure enough, far away and over the clouds, you see a shimmering foreign job—promising romance, adventure, challenge.

If the condition is chronic, if you're serious, better think twice. Not many Americans can be happy in alien lands.

First off, what about wife and family? Regardless of comparative salaries offered, the standard of living is highest in America, and anyone bitten by the wanderlust will have to give up some homeside comforts. Will your family be willing to make this sacrifice for foreign adventure?

Cost of living is much lower in some countries, it is true. And many firms offer inexpensive meals in canteens, subsidized rents, a 13th check at Christmas time, cheap vacations in company-owned hotels, old-age pensions, etc. But remember, salaries will be proportionately lower.

How about the language? To assume that everyone knows English is risky. Some companies abroad rely on English as much as we do, but to accept a position in any non-English speaking country without a good working knowledge of the native tongue is social suicide.

Who pays for transportation? Most companies will pick up the moving tab for you and family. In Germany and Sweden, companies will pay transportation costs only in very special cases.

On the next page is a rundown of the employment situation for engineers, country by country in alphabetical order:

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AUSTRALIA Demand for engineers here is strong. The Commonwealth Government maintains a special section of its employment service called Executive and Professional Appointments, and its offices are located in all capital cities. Principal universities also maintain Appointments Boards for graduates (not necessarily of their own university).

Salaries are low—$100 a week is on the high side, though specialized engineers can command more. Food, accommodation and entertainment are cheaper than in the US; cars, appliances and other durables are substantially more expensive. Engineers are not paid as well as most of the other professions.

Warning: Engineers over 45 will find it difficult to obtain a job.

ARGENTINA The product engineer is most sought after, with experts in industrial organization, refining, electronics and steel furnaces next in demand. The trouble is that most Argentine firms prefer a European engineer because he is easily satisfied with living conditions. Salaries range from $110 a month for a young Argentine to $1000 a month for a top-notch imported engineer. Contact:

Ministerio de Obras Publicas de la Republica Argentina,
Subsecretaria, Av. 9 de Julio, 1925, Buenos Aires

Centro Argentino de Ingenieros,
Ing Ernesto Garcia Olano, Cerrito 1250, Buenos Aires

Union Industrial,
President, Ing. Pascual Gambino, Av. de Mayo 1157, Buenos Aires

BRAZIL Like Argentina, Brazil is a growing industrial country needing specialists in all phases of mechanical, electrical, chemical, atomic and plastics engineering. Only civil engineers are not short in supply. Salaries are considered high, but inflation makes saving hard.

There are certain legal barriers: In order to get a permanent visa (and this is advisable for US tax benefits) you must prove that you already have a job contract and the company or government organization must vouch for the visa application. A list of the necessary documents for a permanent visa may be obtained at any Brazilian consulate.

If an American wants to be a "registered engineer," and many companies insist upon it, he must pass an exam (given in Portuguese) and also join the engineering society in the city of his residence. Society members are civil engineers at present; mechanical engineers simply belong to the same organization.

Best contacts for employment are either through large US companies with factories in Brazil (GM, Ford, Willys, GE, IT&T, Gardner-Denver, Union Carbide and others listed by the US Department of Commerce) or through leading banking organizations with branches in Brazil (First National City Bank of NY, and the

YOU WANT TO WORK ABROAD!

Bank of Boston). Further information can be obtained from: Ministerio de Trabalho, Couselho Regional, Rio de Janeiro. Write your letter in Portuguese.

ENGLAND

Our report from Britain indicates slightly lower status enjoyed by the engineer there as compared with the US. The salary scale is also lower. A graduate engineer can expect to start at between $1500 and $2100; with five years' experience, $3600; 10 years, $4400. Leadership, administration or executive responsibilities put him in the $5600-and-above class with a ceiling around $15,000 for technical directors. As a result of this poor salary and status picture, an American production engineer can get a job in almost any English factory.

Before a British or American firm can employ an American, the employer must satisfy the Ministry of Labor that no British subject with suitable talent or training is available. In most engineering fields, there is a shortage of professional men so nearly all applications presented to the Ministry of Labor are accepted. A total of 1100 Americans were granted permits in the past 12 months. The majority, however, were nontechnical personnel.

The most useful contact for job information is the national agency for engineers and scientists run by the Ministry of Labor. Address—The Professional and Scientific Registrar, Almack House, King St., London, S.W. 1.

FRANCE

Although there is an engineering shortage, it isn't easy for an American to get a job. American firms operating in France must show a ratio of nine Frenchmen for every American employed. As with the English system, a French company wishing to hire an American must first show that there is no French citizen available for the position. Where there is an acute shortage of certain engineering talent, no problem is incurred other than a waiting period of approximately six weeks.

Assuming an American can master the language, his best opportunities lie in the mechanical field. Electronic, chemical and petroleum engineers are in slightly less demand, but the future is bright. The French Manpower Commission estimates that the need for nuclear engineers will double in the next few years while the demand for chemical engineers will increase by 30%. France's greatest need, in terms of quantity, is for the technician. Three technicians are required for every engineer. Average salary with an American company is high—$10,000-15,000 per year. French companies pay much less. The cost of living is not unlike that in the US. Rent in Paris is high ($150-225 per month) and heat and hot water is extra. In the suburbs rent is about 50% less but then transportation must be added. Food is somewhat cheaper than in America and clothing about the same. In general, life in cities other than Paris is about 20% cheaper.

An American firm which has a French affiliate is your best prospect. A French group that may be helpful with information is the French Chamber of Commerce of Paris—27 Ave de Friedland, Paris 8eme.

GERMANY

Very few American engineers are working in Germany and most German firms complain that big money is luring their best engineers to the US. There is a demand for both mechanical and electrical engineers.

Unfortunately, any American engineer going to work in Germany will have to reduce his living standards. Cost of living is a good third cheaper than in the US but average salaries range between $2300 and $3500 annually. The electronics industry pays higher.

A government agency puts out a weekly brochure consisting of "help wanted" and "jobs wanted" columns for which ads are accepted free of charge. Address: Zentralstelle fuer Arbeitsvermittlung, c/o Herr Nold, 1-7 Eschersheimer Landstrasse, Frankfort (Main). Another source is the German magazine *VDI Nachrichten*, VDI verlag GmbH, 77-79 Prinz Georg Strasse, Duesseldorf.

INDIA

Opportunities exist with American firms operating in India, government agencies needing consultants, and the large Indian engineering and chemical firms. Greatest demand is for mechanical, electrical and construction engineers. In all cases, the US head office has the final say. With an Indian firm or governmental project, the selected men are offered contracts on terms recommended by a US consultant. In general, the European engineers have been getting

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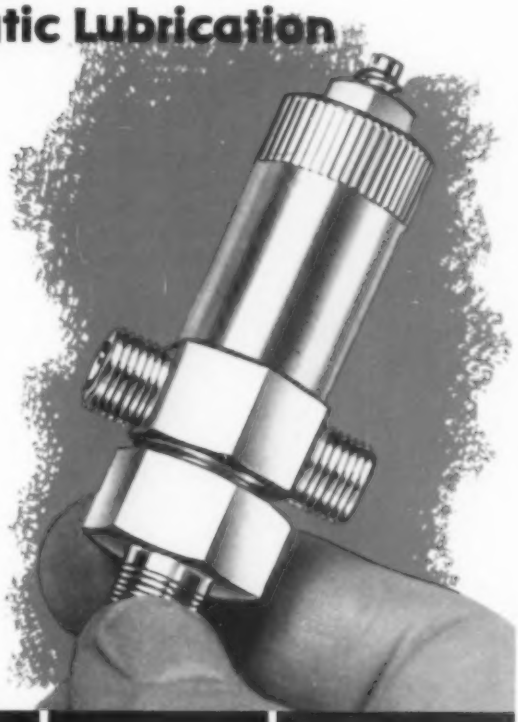

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- Delivers exact amount of lubricant to bearing.

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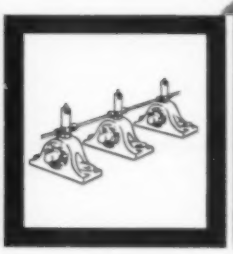
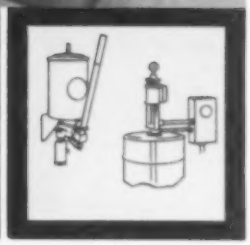


2. Connect Accumatic fittings with copper tubing.

3. Connect sliding, rotary or oscillating parts into tubing system.



4. Provide central pump for supplying lubricant to system.

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preference as they are "less expensive and more adaptable" to the local conditions.

An engineer can expect a salary of 30% to 50% higher than for an equivalent job in the States. In addition, there are perquisites which could include rent-free furnished home, entertainment allowance, car or a car allowance, profit-sharing bonuses, and a paid home-leave for the family after 2½ years. American firms figure a minimum salary of $10,500 annually; Indian firms, less. Taxes are high, but firms can secure tax exemptions for their engineers prior to making an appointment. Such exemptions are initially for the first year, but can be extended to three.

Best way to find a job is either through an American company in the States, or through Tata, Inc., 425 Park Ave., New York City–it represents a group of Indian industries. For information concerning Indian firms and governmental projects, contact the Indian Embassy and Purchasing Mission in Washington, or the Indian Consulate-General in New York or San Francisco.

ITALY

Petroleum and mining engineers are most in demand, but employment possibilities do exist in the electrical, chemical, metallurgical and mechanical fields. The Italian engineer just out of school will get $250 to $300 per month. This is sufficient for comfortable middle-class living for a family of three. Average annual increases are about 6% to 7% of the basic salary. Naturally, salaries for the more experienced engineer are more–determined individually. Roughly, the cost of living in Italy is about a quarter cheaper than in the states. Best bet for contacts–Associazione Nazionale Ingegneri e Architetti, Via delle Terme 90, Rome.

JAPAN

The three fields open to an engineer are road building, irrigation and electric power projects. Most American engineers are obtained under technical assistance agreements with US firms. If you're free-lancing try the Economic Cooperation Section, Ministry of International Trade & Industry, Tokyo.

An engineer sent by a US firm under a technical aid agreement usually gets a living allowance in addition to his American salary. An independent engineer would simply have to bargain with the employer, who would probably pay an American salary, or close to it if the American offered services otherwise difficult to obtain. If he couldn't offer any more than his Japanese counterpart, he probably wouldn't be paid more–about $100 a month. Cost of living is about the same as in the US.

SWEDEN

There is at present a pronounced shortage of design engineers, particularly in the machinery and electronic fields. A residence and labor permit is required but this is merely a technicality.

The American engineer will get the same pay as his Swedish colleague. Average monthly salary–about $300 for routine design work to $600 for a design-management job. Although these figures may not look impressive, the cost of living here is about half that in the US. Taxes are high. There's an 8% tax for pensions.

Job openings are published weekly in the Riksvakanslistan (National Vacancy List) obtained from: Kungl. Arbetsmarknadsstyrelsen, Utlanningssektionen, Fact, Stockholm 12.

For further information read:

Employment Abroad,
Foreign Commerce Dept.,
Washington 6, D. C.

Jobs That Take You Places,
J. Leeming; McKay Co.,
New York; 1953.

Looking for Employment in Foreign Countries,
J. S. Angel;
World Trade Academy Press, Inc.,
New York; 1954.

Foreign Commerce Handbook,
Chamber of Commerce of the US, 1615 H St., NW,
Foreign Commerce Dept.,
Washington 6. D. C. Comprehensive reference book, showing organizational services, functions, etc., of public and private agencies and international economic affairs, up-to-date information on all phases of international trade and investment, extensive bibliographies. $1.50 postpaid.

The Art of Overseasmanship
Syracuse University Press
Syracuse, N. Y. $3.00.

FOR SPRING STEEL FASTENERS

QUALITY BEGINS WITH SHARONSTEEL

The manufacture of fasteners requires steel of the most exacting analysis. Spring quality steels of just the right degree of hardness to permit volume manufacture of hundreds of complicated and complex shapes.

Leading fastener manufacturers look to Sharon as a first source of supply because they have learned they can rely on Sharon to deliver finest quality to precise specifications — coil after coil.

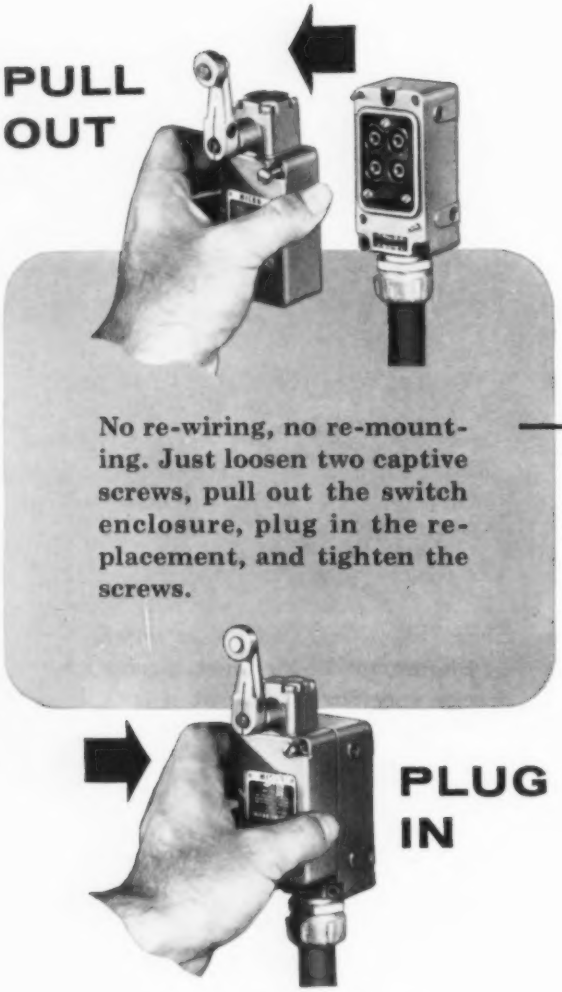
SHARON STEEL CORPORATION

SHARON, PENNSYLVANIA

MICRO SWITCH Precision

These outstanding **NEW** precision switches enable design engineers to save space, time, maintenance and installation costs

High quality with reliability has made MICRO SWITCH the leading manufacturer of precision switches with the largest line of switches from which to select. MICRO SWITCH plants and development laboratories are equipped with scientific tools for painstaking precision, quality control and testing techniques. Field Engineering offices blanket the country. There is always a MICRO SWITCH man near you—ready to cooperate on switching problems.



No re-wiring, no re-mounting. Just loosen two captive screws, pull out the switch enclosure, plug in the replacement, and tighten the screws.

(Send for Bulletin No. 20)

How you can cut "down time" with this "Plug-in Limit" switch

Here's a real timesaver for users of precision limit switches—a revolutionary new precision limit switch that can be replaced IN SECONDS. The MICRO SWITCH "Plug-in Limit" answers a prime requirement for designers of devices for use on high speed automatic production lines. It offers all the features of rugged construction and precise, long-life operation of the industry-proved MICRO SWITCH "LS" Series. Yet the switch enclosure, including all mechanical and electrical parts, is plugged into the terminal block as easily as a radio tube. Dowel pins assure precise positioning.

Switches have uses unlimited

How to get more pushbutton switches on a panel

MICRO SWITCH Series 100 PB Lighted Pushbutton Switches provide an unusually neat, good looking panel. Their compact mounting allows more switches per panel.

Important features include:

Three types of illuminated signal—

(1) one-color buttons, (2) two colors (lighted singly or in combination) and (3) choice of either of two colors—neither of which is visible when button is unlighted.

Large, easily engraved buttons—

Buttons are large enough to allow two lines of clearly legible engraving.

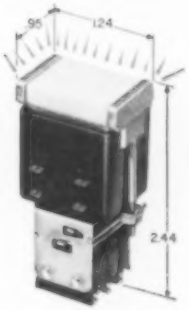
Wide choice of circuitry—

Because separate terminals are provided for each lamp and for each element of the contact structure, these switches permit intermixing of voltages, a-c or d-c current and even combinations of opposing polarities.

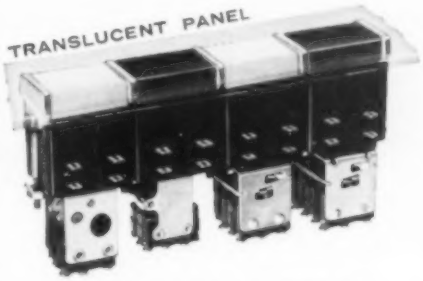
Matching lamp assemblies available—

Matching indicating lamp assemblies are available with the same button and lamp combinations and the same means of mounting as the complete 100 PB switch assembly.

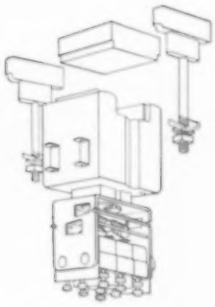
(Send for Data Sheet 143)



Typical switch module on a 3-circuit design.

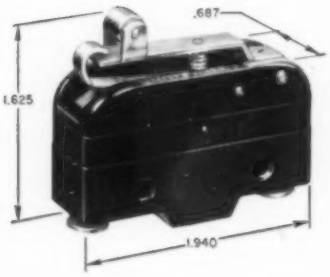


A typical compact assembly of switches in panel slots. Indicates choice of button color and number of circuits.



Exploded view showing switch assembly, button and mounting means.

A roller-lever switch with the stability of pin-plunger switch



A new design in roller-lever actuators is this MICRO SWITCH Type W.

This small, compact roller-lever basic switch is ideal for use of such control mechanisms as radar units, precision machine tools or other devices where precise actuation with little variance in operating points is required.

This Type W switch incorporates a new design in roller lever actuators which gives it an operating stability similar to a pin-plunger switch—low pre-travel, narrow differential travel and close repeatability but also permits exceptionally high overtravel.

The roller is located on top of a double lever. As the roller is depressed, both levers move downward until the switch is actuated. The upper level then proceeds on downward, providing the high overtravel. The limited overtravel given to the snap spring and a low break gives this switch a long, trouble-free mechanical life.

(Send for Data Sheet 127)

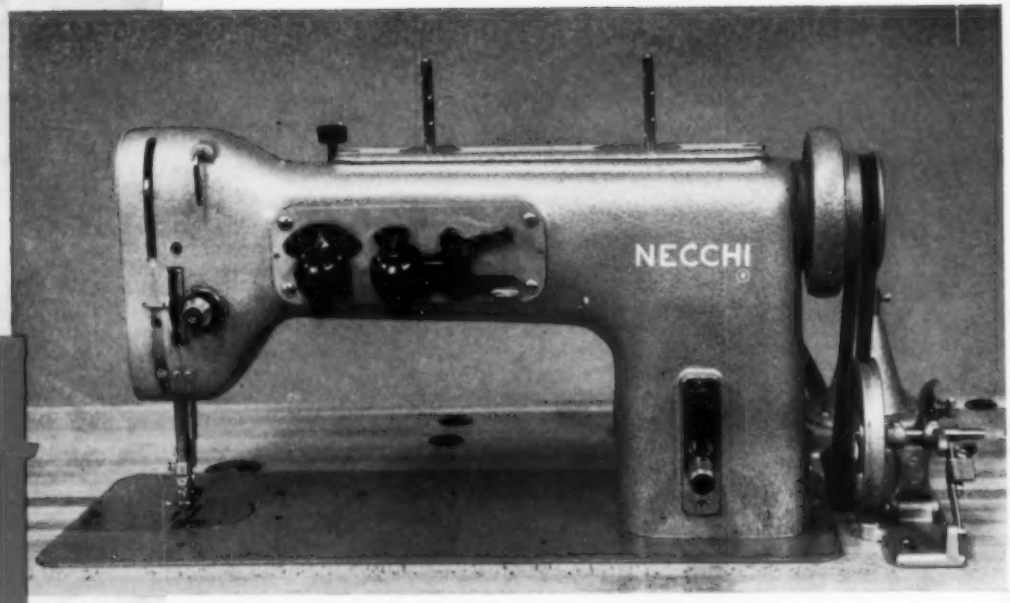
MICRO SWITCH

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

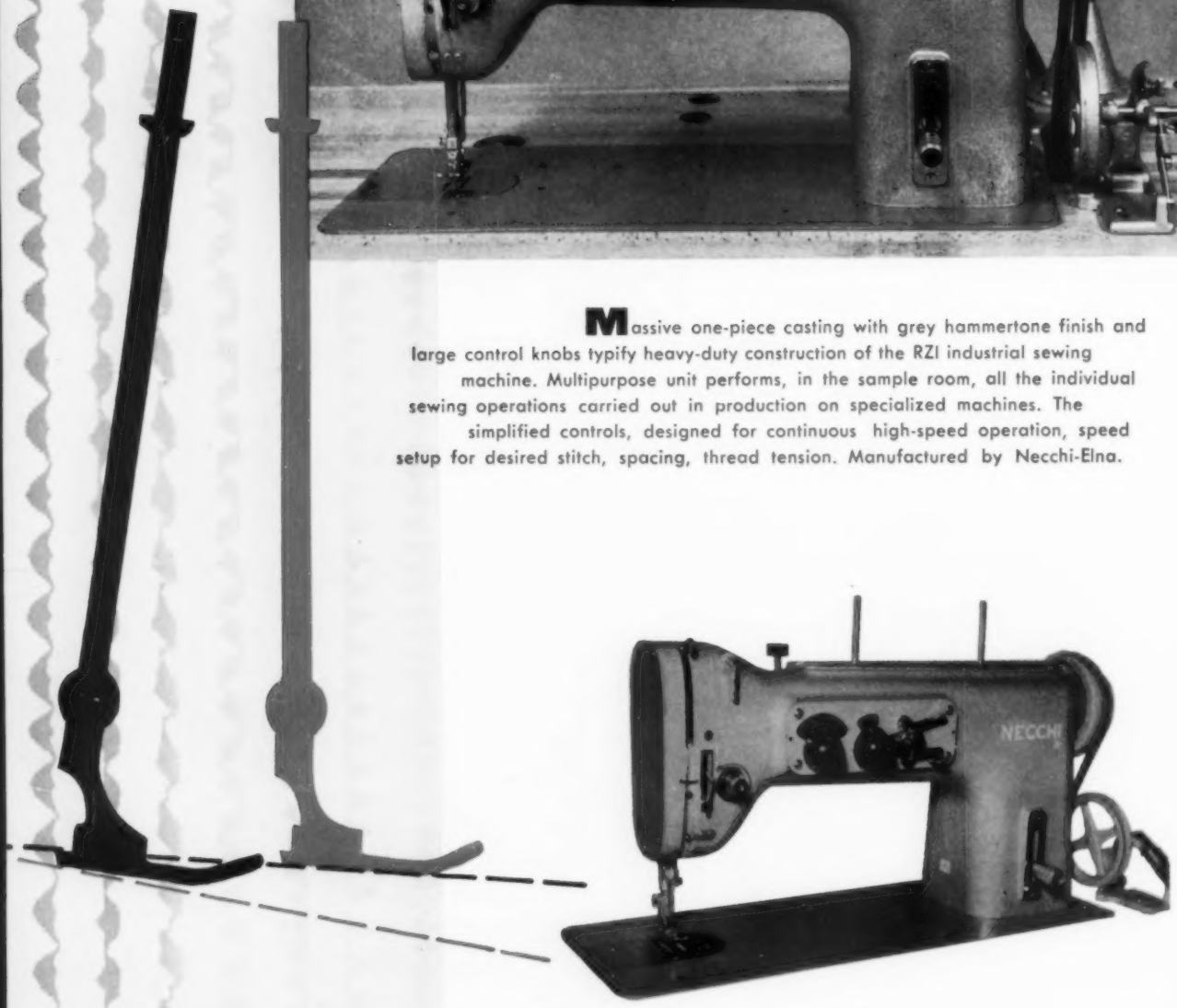
In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS

First in Precision Switching

TRENDS



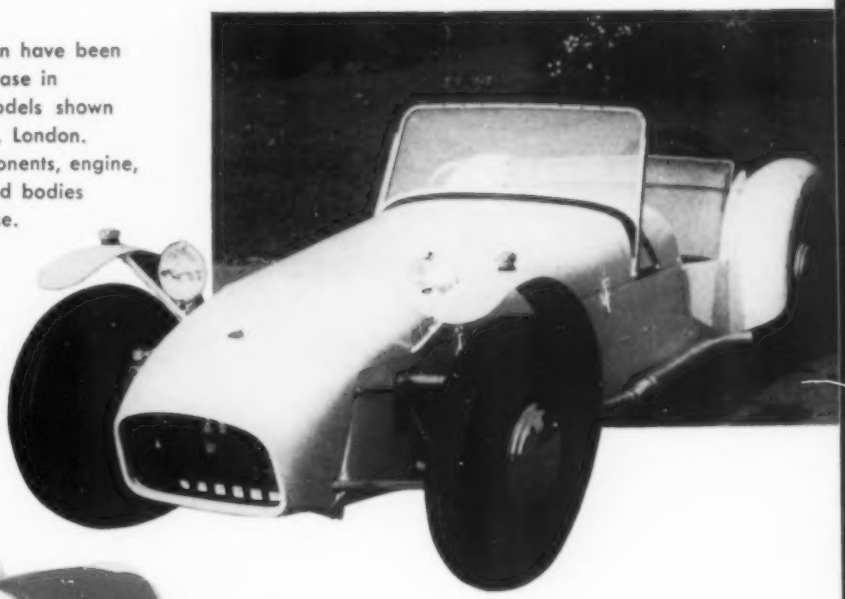
Massive one-piece casting with grey hammertone finish and large control knobs typify heavy-duty construction of the RZI industrial sewing machine. Multipurpose unit performs, in the sample room, all the individual sewing operations carried out in production on specialized machines. The simplified controls, designed for continuous high-speed operation, speed setup for desired stitch, spacing, thread tension. Manufactured by Necchi-Elna.

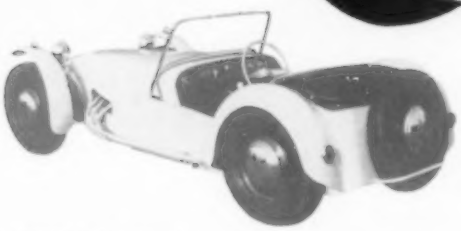


in appearance design...

Diversity of style, performance and operation have been cited as reasons for the steady increase in imported car sales in the US. The three models shown are produced by Lotus Engineering Co., London.

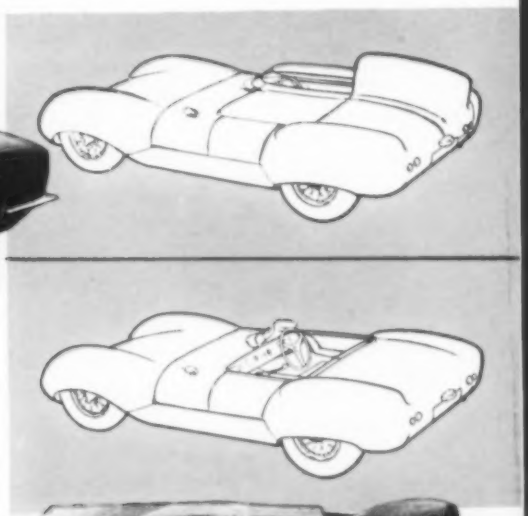
Diversity comes from standard components, engine, brakes, gear boxes, assembled to chassis and bodies designed for a specific purpose.

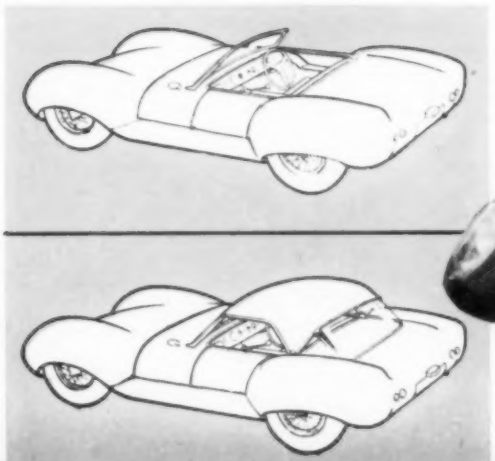




SPORTS MODEL for mild automotive competition is also efficient second car for the spartan commuter.

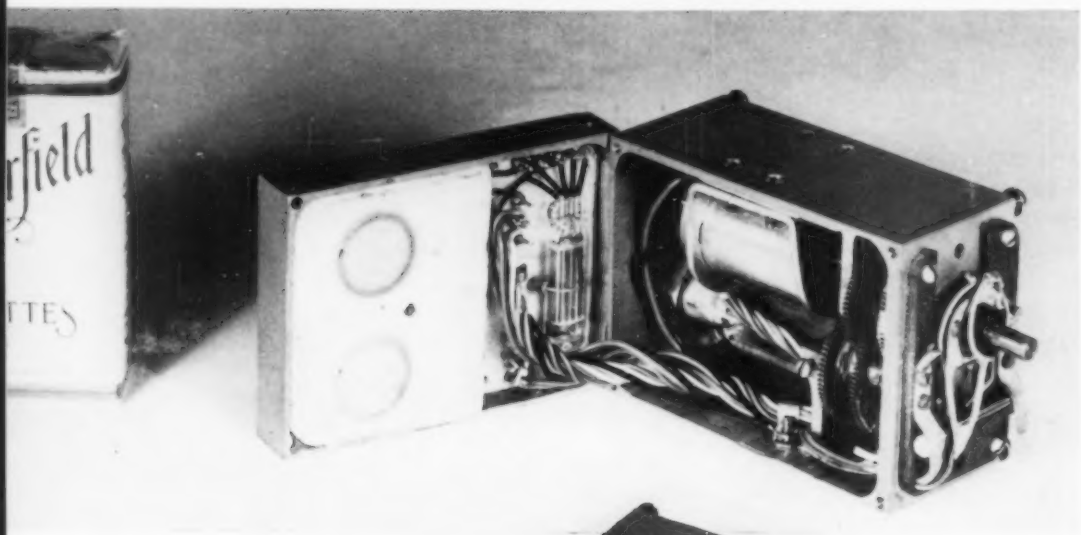
CLOSED TOURING COUPE with unitized chassis-body of glass-reinforced polyester resin provides the comfort of a closed car plus high performance.

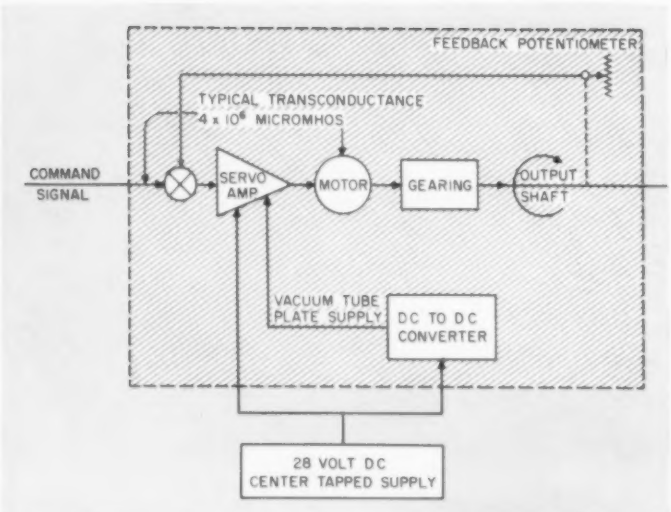




ULTRALIGHT RACING MODEL does over 130 mph, is available with a variety of body styles, engines, braking systems and suspension components.

SIGNIFICANT PARTS





2 to 25 ft-lb of torque in miniature package . . .

is presently provided by this servo system, expected to be capable eventually of providing power ranging from instrument class up to several hundred foot-pounds, without relays. Originally designed for aircraft surfaces control and suitable for machine tools, processing equipment, and small, lightweight, portable products. All three models are transistor equipped, except for input stage where vacuum tube permits substitution for high-impedence systems. Smallest is $1\frac{7}{8}$ x $2\frac{1}{4}$ x $3\frac{1}{4}$ in. long, weighing 12 oz; largest is $2\frac{3}{8}$ x 4 x $6\frac{3}{4}$ in., 5 lb. Present max shaft rotation is 56°, but higher values are possible. Power takeoff is through spur-gear assembly. Feedback is by wirewound potentiometer. Present line priced from $400 up; delivery 3 to 12 wk, depending on model. **Advanced Research Associates, Inc., 41-28-B Howard Ave., Kensington, Md.**

MATERIALS · EQUIPMENT

Digital voltmeter can measure or log data . . . or use it to control equipment or processes. Faster models (encoding rate, 980 readings per sec) have accuracy of 0.05%, other (98 per sec) 0.01% accuracy. There is a choice of binary codes, and output may be as a gated frequency, pulse width or in-line visual readout. Also available for rack mounting; power requirements are 115 v (±10%), 60 to 500 cps at 230 w. Portable dimensions, 9 x 11 x 15 in. deep. Price $2100-2700; 60 days delivery. **Servonics, Inc., 822 N. Henry St., Alexandria, Va.**

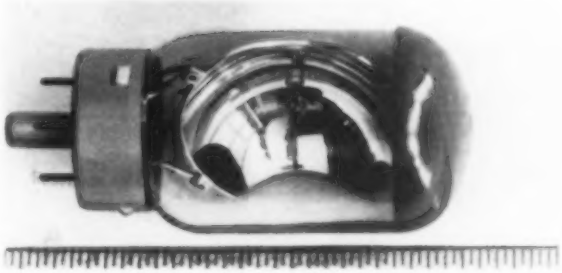
Transducer measures angular rotation . . . by varying amount of mass of its ferromagnetic rotor in fixed air gap. Requires no mechanical stops, because continuous shaft rotation is possible. Operates from −65 through 250 F. Size is 0.875 x 1.62 in. long. Angular range ±4° to ±10°. Price, $380; 12-wk delivery. Temperature-compensated (0 to 250 F). Model is $4.50; 4 to 5-wk delivery. **Ultradyne, Inc., P. O. Box 3308, Albuquerque, N. M.**

Electric lamp with built-in reflector . . . is 3¼ in. high. Sharper focusing capability should aid critical illumination problems and improve photoelectric-cell operation. Rated at 150 w, for 115 v service; rated life 15 hr. List, $5; available from stock. **Sylvania Electric Products, Inc., 1740 Broadway, New York 19.**

Composite film adhesives . . . for honeycomb sandwich construction provide a combination of peel and beam shear strength. Two adhesives, AF-200 and AF-201, are now available. Supported, composite adhesive films consist of a high-strength elastomeric adhesive film on one surface and a self-filleting adhesive film on other surface. Former bonds to facing; latter to core of honeycomb sandwich panel. This concept permits formulation of high-strength bonds at service temperatures of −70 to 250 F. Eliminates priming, solvent hazards and drying problems. Price, delivery information not available. **Adhesives, Coatings & Sealers Div., Minnesota Mining & Mfg. Co., 423 Piquette Ave., Detroit 2.**

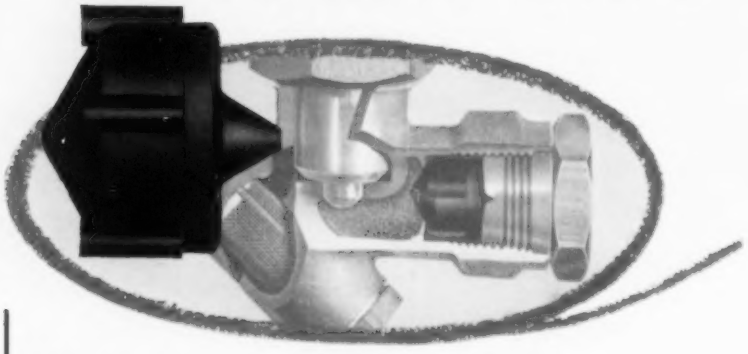
Universal coupling . . . handles angular misalignment of driving and driven shafts to 5°, parallel offset to as much as 0.010 in., and axial end play to 0.090 in. Provides constant rotational velocity, transmits torques to 150 in.-oz, permits speeds to 10,000 rpm, minimizes blacklash, gives high torsional rigidity and operates in temperatures of −10 to 250 F. Hubs are bored to receive $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$ or $\frac{3}{8}$-in. shafts or combinations of these shaft sizes. Over-all dia is 1.078 in. Coupling is $19.80; for over 100 units, $14.85. Small quantities are available from stock. **Metron Instrument Co., 432 Lincoln St., Denver 3.**

Miniature power couplings . . . for use on servomechanisms, computers, missiles and other devices needing small-size components for power transmission. Couplings are nonmagnetic, lightweight and have low elastic yield under torque. Of nonferrous materials, except for stainless setscrews. Available in torque capacities of 3.1, 15, and 60 in.-lb in bore sizes from $\frac{1}{8}$ to $\frac{3}{4}$ in. Designed for speeds to 50,000 rpm, these units help maintain synchronization, relieve bearing loads and compensate for parallel and angular misalignment. Couplings require no lubrication. Standard sizes and types list from $8.80 to $16.00, FOB Warren. **Thomas Flexible Coupling Co., Warren Penna.**



THE SHAPE OF THINGS IN MOLDED RUBBER

MOLDED DIAPHRAGM
GIVES TOP PERFORMANCE IN WATER



APPLICATION:
The diaphragm shown here is the heart of a precision water flow control device for use in various appliances where automatic water flow control is necessary. It automatically maintains one set water flow regardless of inlet pressures or temperatures. This new unusual device is manufactured by a company famous for supplying brass and iron products for the water, gas and plumbing industries.

PROBLEM:
This diaphragm, less than 1" in diameter, must withstand pressures from 10 to 150 lbs. psi. and guaranty water delivery within 10% ± of the valve rate capacity. The diaphragm must also flex in temperatures ranging from 50°F. to 150°F. Mold it and make it work!

SOLUTION:
Acushnet engineers designed and used an injection mold to obtain the necessary precision. Strict production controls were instituted to maintain high quality parts. All neoprene stock prior to molding was checked for physical properties and weight. Samples were taken from every heat for flow tests approximating five days. For extra quality control, stocks that did not produce parts to the spec were scrapped. Acushnet now molds a complete line of precision neoprene diaphragms for this customer.

Acushnet offers complete under-one-roof facilities for the accurate compounding, engineering and precision molding of rubber, silicone and silicone resin parts. Apco technical representatives located in key industrial areas are ready to help you with your problem.

Send for Acushnet "Rubber Data Handbook."

What's Your Shape?

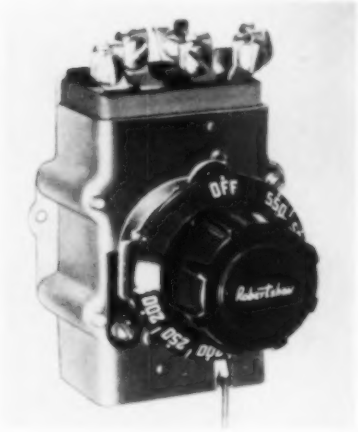
Acushnet

ACUSHNET PROCESS COMPANY
NEW BEDFORD, MASSACHUSETTS

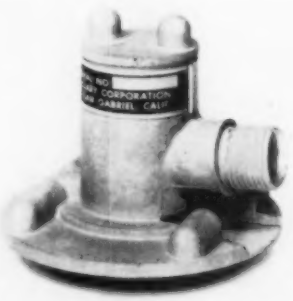
... *Precision Molded* ***RUBBER, SILICONES - "APCOTITE" BONDING***

Address all communications to 768 Belleville Ave., New Bedford, Mass

SIGNIFICANT PARTS
MATERIALS
EQUIPMENT . . .



Electric thermostat . . .
operates in temperatures to 700 F. UL-approved for a rating of 20 amp, 250 v ac. Designed to control three separate heating phases, one of which is continuously On when dial is moved from Off position. Two other phases are controlled thermostatically, and automatically cycle with changes in temperature. Control is available in nine temperature ranges and a variety of suitable dial markings. Contacts and bridges are silver; levers and supports are hardened steel. **Robertshaw Thermostat Div., Robertshaw-Fulton Controls Co., Youngwood, Penna.**

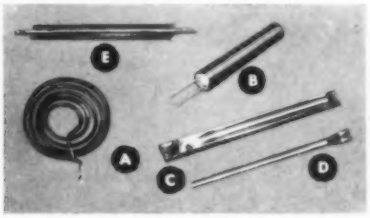


Double-seal drain valves . . .
eliminate draining a container or feed line to correct a valve leak. Valves have a secondary seal that permits the primary valve poppet to be replaced without loss of fluids. The second seal can also stop a leak when immediate primary seal replacement is impossible or inconvenient. Originally designed for use in aircraft fuel tanks and lines. **Clary Dynamics Div., Clary Corp., 408 Junipero St., San Gabriel, Calif.**

How to choose electric heaters of the right type and size for your design

Here is condensed information to help you get the most economical electric heater for your surface heating design problem.

Two factors generally determine which type heater should be used for any particular surface-heating application. They are: the physical characteristics of your product, and the surface temperature required.



General Electric *tubular heaters* (a) can be formed to unusual shapes and may be "cast in metal" as part of your product during manufacture. They may also be located in grooves, inserted into drilled holes, immersed in liquids, wrapped tightly around the surface or spaced away.

G-E *cartridge heaters* (b) are ideal for "spot" heating of small areas. Short and compact, they can be easily inserted into drilled holes within the machine or surface.

For flat metallic surfaces, such as hot plates, platens and dies, *strip heaters* (c) may be clamped on or spaced away. General Electric *insertion heaters* (d) are ideal for heating hollow bolts for high-pressure steam-shell joints to prevent steam leakage.

For warming tables, and preheating plates, G-E *vane heaters* (e) may be clamped on or spaced away.

To figure the amount of heat required for your application:

1. Find the volume in cubic inches of the material in process.
2. Figure needed temperature rise in degrees F (subtract initial temperature of material from desired final temperature).
3. Find heat absorbed by material (Table 1 applies to all materials except those listed in Table 2). Values from Table 2 should be added or subtracted from values in Table 1 to correct it.
4. Determine the total surface area of the platen.
5. Using this area and the desired final temperature, check Table 3 to get heat losses of platen.
6. Add kilowatts computed in Step 3 to those computed in Step 5. You now know how much heat is required.

For complete information on sizes and ratings of General Electric heaters, send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

TABLE 1—HEAT ABSORPTION IN KILOWATTS OF MATERIAL IN PROCESS

Volume of Material in Process (cu. in.)	Temperature Rise in °F					
	50	100	150	200	250	300
1	.006	.012	.018	.024	.030	.036
5	.030	.060	.090	.120	.150	.180
25	.090	.180	.270	.360	.450	.540
100	.360	.720	1.08	1.44	1.80	2.16
500	1.80	3.60	5.40	7.20	9.00	10.8
1000	3.60	7.20	10.8	14.4	18.0	21.6

This table is based on a ten minute working cycle. If working cycle is other than 10 minutes use following formula to correct values: 10 divided by the number of minutes in the cycle times the kilowatts given above equals the kilowatts at the new cycle. Table 1 will apply for all materials except for those listed in Table 2. Apply correction factor if needed.

TABLE 2
CORRECTION FACTOR

Material in Process	Subtract or Add % as indicated to figure in Table 3
Aluminum	−30%
Dry Wood or Paper	−50%
Wet Wood or Paper	+20%
Glass	−40%
Rubber	−30%

TABLE 3*—PLATEN HEAT LOSSES IN KILOWATTS

Surface area of metal platens in sq. inches	Final temperature in degrees F of metal platens			
	100	200	300	400
100	.024	.080	.160	.280
250	.060	.200	.400	.700
500	.120	.400	.800	1.40
1000	.240	.800	1.60	2.80
2000	.480	1.60	3.20	5.60
3000	.720	2.40	4.80	8.40

*This table based on platens being completely uninsulated.

Section A723-12, General Electric Co.
Schenectady 5, New York

Please send GEA-6146, Surface Heating Handy Selector Guide and GEC-1005, Catalog of G-E Heaters and Devices.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

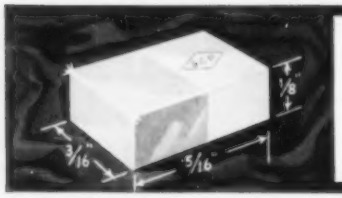
GENERAL ELECTRIC

"Usually Outstanding Service and Life"

—that's SUPERIOR BRUSHES on BELL HELICOPTERS

A clear and welcome statement from the Bell Helicopter Corporation of Fort Worth, Texas, needs no embroidery:

"The silver graphite brushes supplied us by Superior Carbon Products, Inc. are used in conjunction with our XH-40 in flight tracking actuator. It is expected that in this application they will give their usually outstanding service and life."



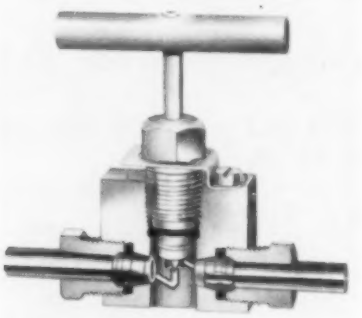
Investigate Superior Silver Graphite Grades. They excel for many critical electrical requirements.

We have had the opportunity of recommending similarly successful Superior grades for exacting, *especially new*, applications. May we look into your problem?

SUPERIOR CARBON PRODUCTS, INC.
9115 GEORGE AVENUE • CLEVELAND 5, OHIO

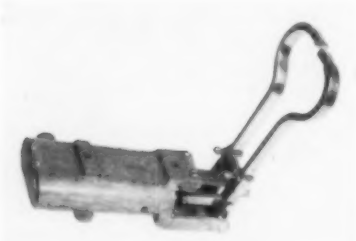
SUPERIOR CARBON BRUSHES "Since 1919"

SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



High-pressure valves . . . and fittings are stainless steel. Setup time is reduced because no threading or beveling is required. A nut and internal sleeve lock the cut tubing. Seating is assured by an internal sleeve that is forced forward into the body taper as nut is tightened. Pilot of the sleeve contracts, forcing the cutting edge of the sleeve to shear a groove into the outer surface of the tube, making a tight joint between fitting and tube. Filters may be inserted in inlet line, and blowout disks are available for pressures of 700 to 10,000 psi. **American Instrument Co., 8030 Georgia Ave., Silver Spring, Md.**

Metal adhesive . . . bonds rubber and fabric to metal or plastic, and rubber to metal. It provides a flexible, shock-resistant bond that is impervious to most oils, acids and alkalies. Adhesive is self-curing, requiring no heat, catalyst nor accelerator. Can be applied by brush or coating machine. **Rubba, Inc., 1015 E. 173rd St., New York 60.**



Dual-lever pneumatic valve . . . operates on inlet pressure of 3300 psi and applies differential pressures from 0 to 1000 psi depending on force exerted through each of two operating handles. Weighs 2.4 lb. **Walter Kidde & Co., Inc., 675 Main St., Belleville 9, N. J.**

DOW

Plastiatrics

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

EFFECTIVE CONTROL OF VARIABLES DEVISED FOR INJECTION MOLDING OPERATIONS

AUTOMATIC ADJUSTMENT IMPROVES QUALITY AND UNIFORMITY OF MOLDED PARTS

Frequent mention has been made in the past few years of using a pressure signal to control the operation of an injection molding machine directly from the plasticized zone. This would help to regulate the pressure and temperature sequence precisely and uniformly in the injection mold. Needless to say, a superior quality of molded parts would result.

Dow Plastics Fabrication engineers have examined several of the possibilities and have tested the following control on which U. S. Patent 2,786,234 was obtained.

The system used for controlling the injection pressure consists of: (1) an instrument placed in the mold to measure the plastic pressure; (2) a recorder with pneumatic control; (3) an air operated relief valve connected to the hydraulic line of the molding machine. Figure 1 gives you a graphic view of the installation of such a system.

With this automatic controller, setting controls becomes easier and time and material required to get the mold into production are saved. Flashing and short shots do not occur following an interruption in the normal molding cycle. Changes in material or viscosity are taken in stride without readjusting the controls. Finally, uniformity of piece weight is excellent.

This particular system works effectively on heavier types of moldings. But, to mold thin-walled parts where faster cycles are necessary, superior injection molding depends largely on the placement of the pressure transducer. Whether you consider placing it directly in the mold cavity, in auxiliary cavity, the runner system, or in the nozzle, each location must be thoroughly evaluated for its respective advantages and drawbacks.

The machine used in testing the effectiveness of the system was equipped with a weigh feeder whose accuracy was ±.6 grams of the granular feed. When molding this part on a conventional cycle, the variations in the weight of the part were ±.4 grams. But, by using the pressure control system, these variations were reduced to ±.16 grams. See these results in Figure 2. This is only one of a number of advantages to be derived from the pressure control system.

Plastiatrics studies and research continue in this area and similar fields in an effort to find practical solutions to problems in plastics formulation, design, molding and finishing. For your copy of our technical bulletin entitled "Pressure Control for Injection Molding Machines", write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept., 1518D.

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GENERAL PURPOSE
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- STYRON 666M (Easy Flow)
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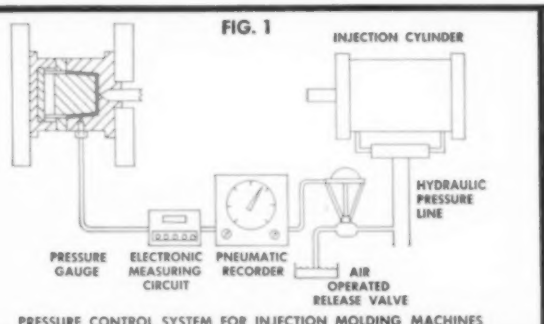
- STYRON 777 (Medium Impact)
- STYRON 440 (Heat Resistant)
- STYRON 480 (Extra-High Impact)

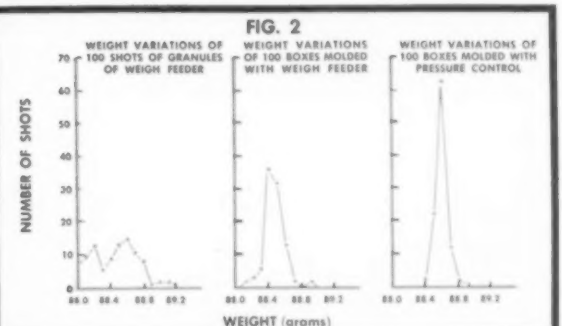
HEAT RESISTANT
- STYRON 683
- STYRON 700

FIG. 1



PRESSURE CONTROL SYSTEM FOR INJECTION MOLDING MACHINES

FIG. 2


WEIGHT VARIATIONS OF 100 SHOTS OF GRANULES OF WEIGH FEEDER
WEIGHT VARIATIONS OF 100 BOXES MOLDED WITH WEIGH FEEDER
WEIGHT VARIATIONS OF 100 BOXES MOLDED WITH PRESSURE CONTROL
NUMBER OF SHOTS
WEIGHT (grams)

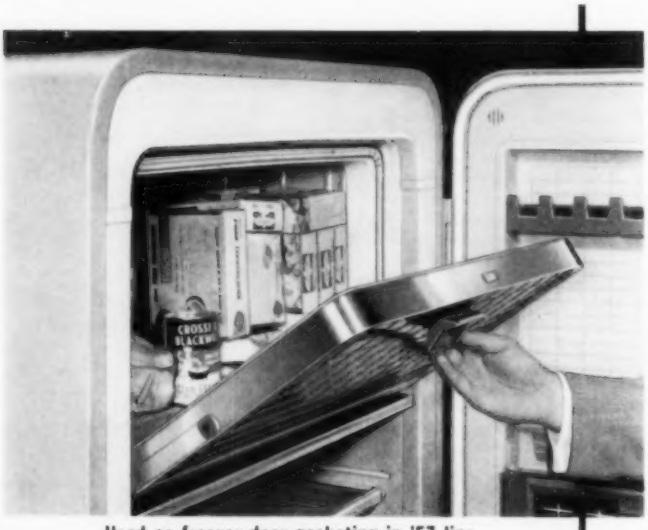
YOU CAN DEPEND ON DOW

Rubatex Gaskets meet special Kelvinator requirements

Rubatex closed cellular structure gives Kelvinator engineers just what they want . . .

"a non-moisture absorbing material . . . one that has sufficient resiliency to permit a firm, quiet door closure . . . plus a gasket that can be depended upon for a tight effective seal against loss of cold and entry of warm, humid air."

In addition to these important features, Kelvinator engineers also use Rubatex because it is convenient to work with and easy to apply in the assembly process.



Used as freezer door gasketing in '57 line — continued in Kelvinator '58 line

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Great American Industries, Inc.
Bedford, Virginia

Just fill out and mail for free sample and more information about Rubatex Closed Cellular Rubber Gasketing.

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Company _____

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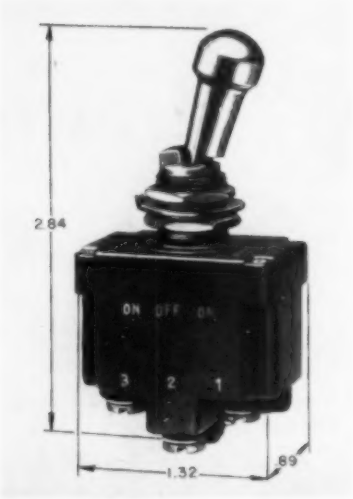
SIGNIFICANT PARTS MATERIALS EQUIPMENT . . .



Toggle switches . . .

have integrally designed lever locks and require a pull of about 0.090 in. to change lever positions. Lever prevents false actuation from objects snagging or hitting toggle lever. Lever itself is oversize and has knob on end. Silicone seal between cover and case prevents moisture and dust from entering plastic case. Available with 11 toggle-locking positions in three circuitry types: single-pole, double-pole, four-pole. Rater electrically at 20 amp, 30 v dc, resistive load. **Micro Switch, Div. of Minneapolis-Honeywell, Freeport, Ill.**

Thermal time-delay relay . . .

is a miniature unit with high shock and vibration characteristics. Relay elements are stainless steel. Delays are said to be as low as 250 millisec. ⅛-in. dia silver contacts carry 3 amp at 115 v, 60 cps noninducting current, for a min of 250,000 operations. Operates on from 6 to 115 v, with timing ranges ½ sec to 3 min, normally open or closed. Max contact–recovery time is 2 sec. Available in glass or metal enclosures. Ac or dc heater voltages. Octal-base units are 1⅝ in. with 7 and 9 pin base, 1¼ in. high. **Line Electric Co., 271 S. 6th St., Newark 3, N. J.**

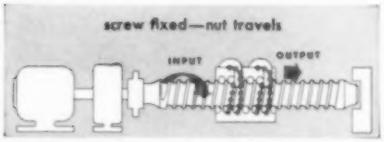
Plastic diaphragm valve . . .

operates to 300 F at 50 psi and has a chemical resistance approaching that of glass. Compatible with plastic or metallic piping. Available in handwheel-operated, lever-operated, sliding-stem, and air-operated types. Sizes range from ¼ through 2 in. with screwed ends only. **Hills-McCanna Co., 4622 W. Touhy Ave., Chicago 30.**

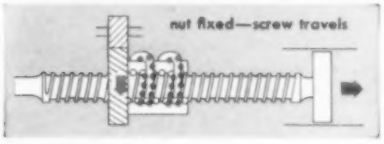
Here's your new ANSWER

PHOTOGRAPHED ACTUAL SIZE
BALL CIRCLE DIAMETER: 3/16 inch.

WORLD'S SMALLEST ball/bearing SCREW SOLVES CRITICAL MINIATURE POSITIONING/CONTROL PROBLEMS



NUT TRAVELS: When rotary motion is applied to the screw, the b/b nut glides along the axis of the screw on rolling steel balls, converting rotary force and motion to linear force and motion with 4/5 less torque than acme screws.



SCREW TRAVELS: When rotary motion is applied to the b/b nut, the screw glides along its longitudinal axis on rolling steel balls, converting rotary force and motion to linear force and motion with unprecedented efficiency.

An unprecedented achievement in minimum size and weight—maximum efficiency, dependability and service life for ultra-precise controls.

It's another first from Saginaw—and the possibilities it opens up for improved electrical and electronic controls are limited only by your imagination! Radar tuners, missile and rocket guidance and telemetering systems, automatic switchgear, electronic machinery controls are just a few of the applications where this new miniature Saginaw b/b Screw will solve critical positioning/control problems. *It's so compact and light,* you can save substantially on space and weight. *It's so efficient,* (over 90%) you can use much smaller motors and gear boxes. *It's so precise,* you can position components within .00005 inch per inch of travel. *It's so dependable,* you can rely on remarkably long service life even in adverse environments.

You will find our 1958 Engineering Data Book extremely helpful in planning applications, or experienced Saginaw engineers will gladly make specific recommendations without obligation. Just phone, write or mail the handy coupon.

Saginaw

ball/bearing Screw

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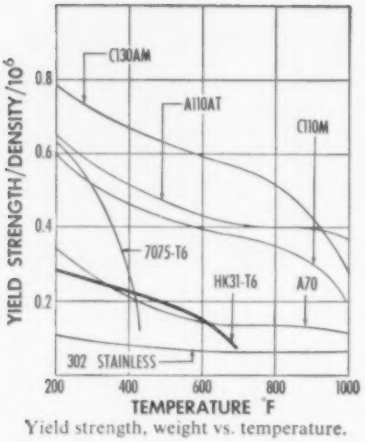

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NEW LITERATURE

Treasury of Foreign Cars Old & New

FLOYD CLYMER, *Published by McGraw-Hill Book Co. Inc., 330 W. 42nd St., N.Y. 36. 8½x11, 212 pp. $7.50*

This selective album of yesterday's progress and interesting present-day automotive designs from abroad provides a colorful record of the car as it evolved from a rich man's plaything to everybody's necessity. Expensive prestige models planned for export are shown together with economy cars for home consumption. The design ingenuity showered on many of these foreign cars is a refreshing change from the more static designs of the contemporary American auto designer.

The manufacturers' descriptive material that accompanies some of the catalog illustrations indicates there was a day when automotive improvement was not always limited to increasing the chrome trim or tail-light size. Self-starters, electric generators, electric lights, four-wheel brakes, closed bodies and pneumatic tires were bold steps forward.

The section dealing with today's autos makes clear that foreign designers have lost none of their willingness to experiment. The variety and ingenuity of foreign cars today has been cited as one reason for their increasing popularity in the US.—JJK

Numerically Controlled Positioning Systems

Abstracted from "31 Numerically Controlled Point-to-point Positioning Systems —Part I," by J. D. Cooney and B. K. Ledgerwood, Control Engineering, Jan. 1958, 330 W. 42nd St., New York 36.

All known (31) domestic and foreign numerically controlled point-to-point positioning systems for use with jig borers, drill presses, punch presses and other types of machines tools are to be described in this three-part article. Twelve are in Part I.

Data includes cost, equipment furnished, accuracy, table travel, speed, internal system operation. Techniques for data input, data processing, analog-to-digital conversion, position measurement, actuation are discussed. A checklist of system characteristics is arranged by manufacturer.

Solid-state Phenomena in Circuitry of the Future

Abstracted from "Future Circuit Aspects of Solid-state Phenomena," by E. W. Herold, RCA, Proceedings of IRE, Nov. 1957, 1 E. 79th St., New York 21.

Electrical and electronic circuits are expected to rely more and more on solid-state phenomena and solid-state devices to perform increasingly complex functions. Several phenomena are discussed, including superconductivity, molecular amplification, magnetic effects in semiconductors, nonlinear capacitance in junctions.

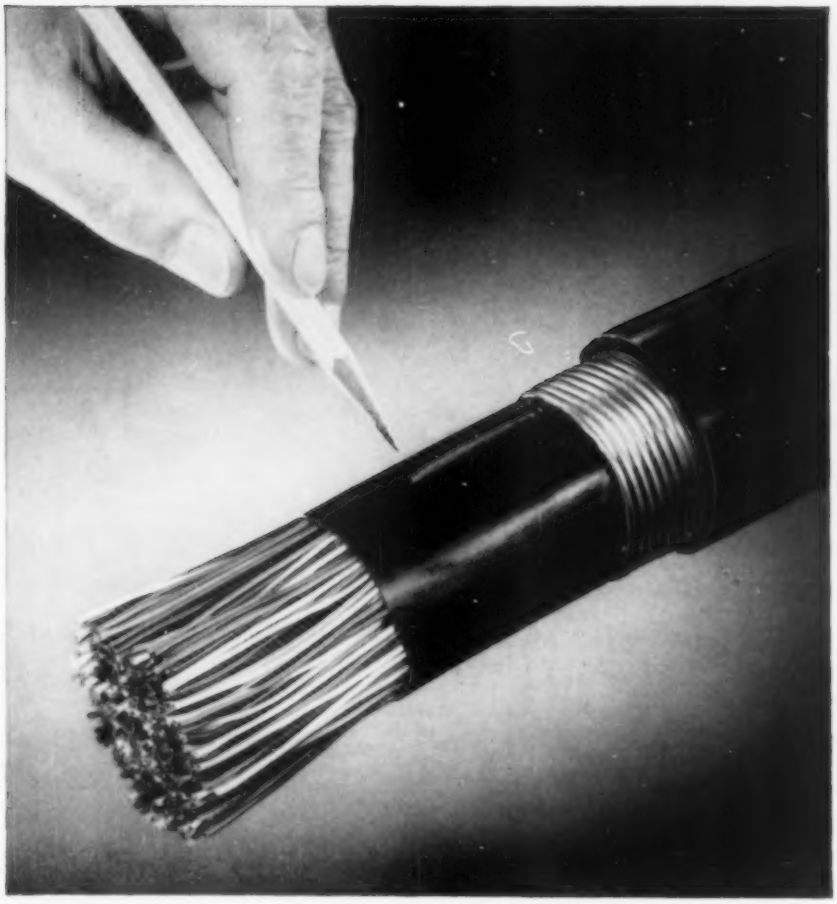
Potential advantages of controlled inhomogeneity in materials (mainly based on controlled distribution of impurities to create effect of an internal electrical field) are also discussed. Controlled inhomogeneity may lead to solid devices able to combine functions of many conventional circuit components and wiring.

STEEL CASTING DESIGN—Booklet, 34 pp. 1958 revised edition of "Fundamentals of Steel-Casting Design," supplemented with data derived from recent SFSA research work. Discusses why designers and design engineers should concern themselves with steel casting design, what they should know about steel castings, rules of steel casting design. Characteristics and properties of steel castings are given, supplemented with illustrative curves, drawings and photos. Steel Founders' Society of America, 606 Terminal Tower, Cleveland 13.

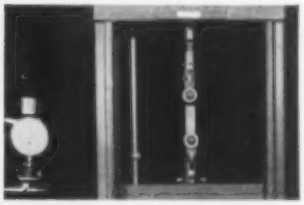
LAMINATED PLASTICS, VULCANIZED FIBRE—Catalog, 8 pp. Summarizes application and engineering data. Descriptions and data tables aid engineers and designers to select and apply these basic materials for electrical and mechanical components. A general-data table itemizes specifications, dimensions, colors and applications for 19 grades of laminated plastics, and is followed by engineering data chart on physical, mechanical and electrical properties. Describes general uses and types of vulcanized fibre and a selector chart with characteristics, colors, sizes and specific uses for various grades. Taylor Fibre Co., Norristown, Penna.

BIMETAL THERMOSTATS—Data sheet, 2 pp. Design data for adjustable and nonadjustable thermostats. Includes mechanical characteristics, such as size and materials and operating information, such as range of temperatures controlled, voltage rating and current rating. With dimensional diagrams. Norwalk Thermostat Co., Norwalk, Ohio.

ELECTRIC MOTOR CONTROLS—Catalog 5800, 56 pp. Selection tables give horsepower, motor speed, heater size and heater ampere ratings plus enclosure choices and prices. Also contains design data, stocking information and ordering instruction for magnetic starters and contactors, drum controllers, pressure switches, pushbuttons and other motor control and pilot devices. Indexed. Furnas Electric Co., 1050 McKee St., Batavia, Ill.



Can you use the unique combination of properties offered by **"MYLAR"?**



STRENGTH . . ."Mylar" is the strongest of all plastic films. Instron tester shows an average strength of 20,000 lbs. psi.

CHEMICAL RESISTANCE . . ."Mylar" film is unaffected by oils, grease, most acids and alkalies, moisture and solvents!

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Core binder tape made with Du Pont MYLAR® helps Western Electric speed production of communication cable

PROBLEM: Western Electric's new long-life, high-dielectric communications cable posed a challenging problem for production engineers. The problem was this—how to efficiently extrude an outer jacket of polyethylene without fusing the inner pairs of wires also coated with polyethylene.

SOLUTION: After extensive tests with combinations of materials, a tape of Du Pont "Mylar"* polyester film and rubber was selected to act as a heat barrier.

RESULTS: Western Electric reports that abrasion-resistant "Mylar", with its hard, durable surface, helps the core binder tape run smoothly on its equipment without snagging or tearing. Because of its high tensile strength and melting point, "Mylar" helps prevent corrugations of the electrostatic aluminum shield from breaking through the tape and shorting the cable.

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Application _____

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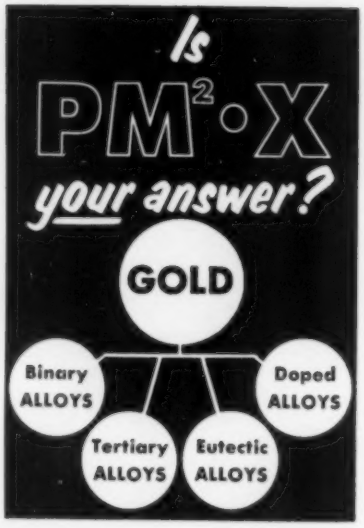

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JAN.

28-31 **National Technical Conference,** Society of Plastics Engineers at Hotel Sheraton-Cadillac, Detroit, Mich. Over a hundred papers will cover developments, methods, materials, and techniques in plastics.

29-30 **Midwest Welding Conference,** sponsored by Armour Research, Illinois Institute of Technology, and Chicago section, American Welding Society, at Illinois Tech Chemical Building, 3255 Dearborne St. For information contact Harry Schwartzbart, 10 West 35th St., Chicago.

FEB.

4-6 **Society of the Plastics Industry,** Reinforced Plastics Div., Technical and Management Conference, Edgewater Beach Hotel, Chicago. For information contact the Society, 67 W. 44th St., NYC.

MAR.

3-6 **ASME Gas Turbine Power Div.,** Conference and Exhibit, Shoreham Hotel, Washington. Exhibits are limited to gas turbine power plants, component parts, materials and accessories. For information contact ASME, 29 West 39th St., NYC.

12-14 **Pressed Metal Institute,** Spring Technical Meeting, Sheraton-Cadillac Hotel, Detroit, Mich. For information contact the Institute, 3673 Lee Road, Cleveland, Ohio.

16-21 **4th Nuclear Engineering and Science Conference,** managed by American Institute of Chemical Engineers, with participation by ASME, AIEE, American Institute of Mineral, Metallurgical, and Petroleum Engineers at International Amphitheater, Chicago.

17-20 **ASME Aviation Division,** Conference at Statler-Hilton, Dallas, Texas. For information contact the Society, 29 West 39th St., NYC.

19-20 **ASME Committee on Management Conference,** Somerset Hotel, Boston, Mass. For information contact the Society, 29 West 39th St., NYC.

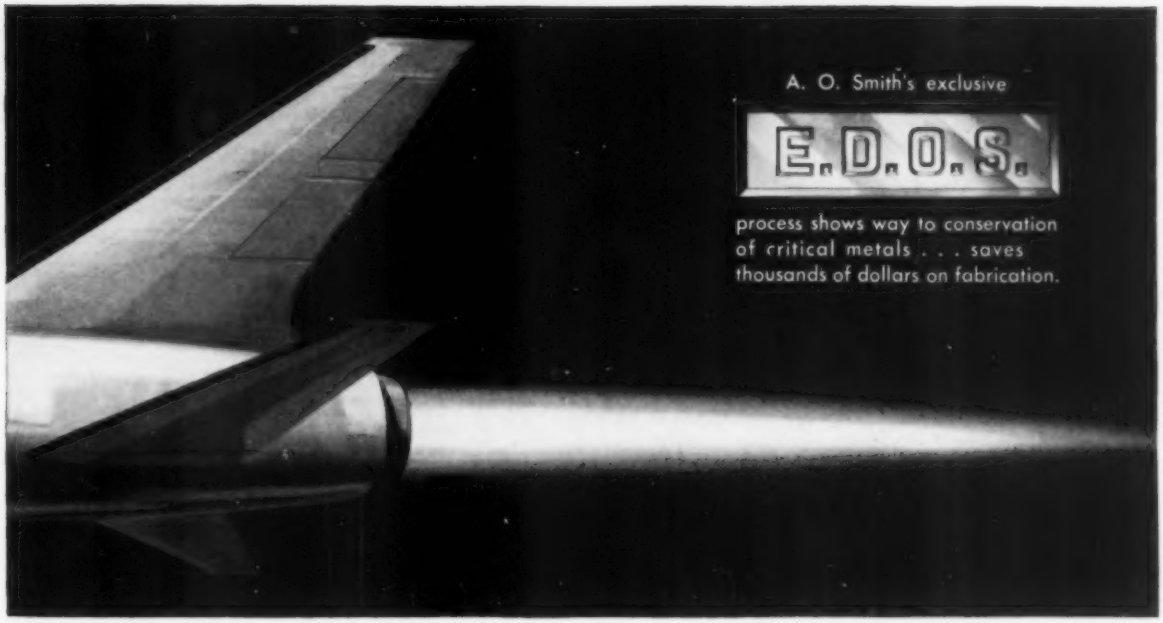
24-27 **IRE National Convention** and Radio Engineering Show, Waldorf-Astoria Hotel and New York Coliseum. Program includes 275 papers covering fields of all 27 IRE professional groups. 850 exhibitors are participating in the show. For information contact E. K. Gannett, 1 East 79th St., NYC.

26-28 **American Power Conference** sponsored by Illinois Institute of Technology in cooperation with 14 other colleges at Hotel Sherman, Chicago. A program of 90 papers will cover various aspects of the electrical power industry including a progress report on nuclear developments. For further information contact Frank Judd, 35 West 33rd St., Chicago.

31-April 2 **American Institute of Electrical Engineers,** Southwest District Meeting at Mayo Hotel, Tulsa, Okla. The 14 technical sessions will cover advances in systems engineering, engineering education, aircraft, power distribution, transmission and communication. For information contact the Institute, 33 West 39th St., NYC.

APR.

14-17 **ASME Design Engineering Conference and Show,** International Amphitheater, Chicago. For information contact the Society, 29 West 39th St., NYC.


A. O. Smith's exclusive
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process shows way to conservation of critical metals . . . saves thousands of dollars on fabrication.

A-286 alloy ring for a finger of flame

Today, products are becoming increasingly complicated and costly. Further, there's mounting pressure to put them into production in the shortest possible time.

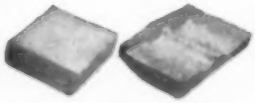
That's where E.D.O.S. (Engineered Designs for Optimum Structures) may fit into your picture — speed-wise, cost-wise.

This A. O. Smith process consists of precision forging and contour rolling followed by flash or fusion welding. With it, even the most difficult-to-work metals can be shaped . . . quickly fabricated into the parts you need with only minimum finish machining (in most cases). There's no wasted metal, no need for expensive successive machining operations to "whittle" a part down to size. Parts cost savings of up to 70% have been reported.

A. O. Smith's 9,000-ton, single-action, precision-forging press is the only one of its size in the country. And their 1,800-ton contour rolling mill is also the only one of its type and size in the country.

Since World War II, E.D.O.S. has helped make A. O. Smith a major supplier to the aviation, rocket, missile and related industries. A. O. Smith products are currently helping to accelerate the VANGUARD project.

E. D. O. S. applied to a jet engine case



At left is one of the four high-nickel alloy blanks. At right, the same blank after pre-forging. Basic materials cost about 50% less than conventional processes.

After pre-forging, each piece is rolled and re-rolled to attain the final configuration. Piece shown has gone through initial rolling.

Then, the pre-forged and rolled blanks are formed into quadrants.

. . . and the 4 quadrants are flash-welded to form the finished part. Relatively small machining job still needed is done by the customer.

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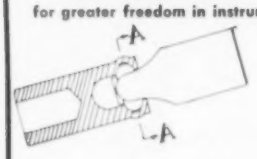

Features • Zero backlash • Maximum operating angle of 30° • Lightweight • Sealed-in Lubrication

DIMENSIONS

Part NO.	ID	OD	OL	WGT.
SBS	SOLID	3/16	1-1/32	
1BS	.0938	"	"	.005
2BS	.125	"	"	"
3BS	.156	9/32	1-3/8	.013#
4BS	.1875	"	"	"
5BS	.2188	3/8	1-3/4	.031#
6BS	.250	"	"	"

(Also available as double joints)

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Publisher's Postscript...

Engineer Your Reading

There are few fields of human endeavor more demanding, and requiring more continuous study, than the field of product-design engineering. College courses, textbooks, and even most engineering seminars lag far behind working industrial development and design.

A new alloy, a new plastic, a new component, can obsolete thousands of hours of engineering time overnight. The sudden availability, in quantity, of a formerly scarce part or material may suggest a complete product redesign. The ingenuity of competition may dictate an entirely new approach.

This intense activity puts a heavy burden on the engineer. How can he possibly expose himself to these many new ideas and still have time to perform his job? The easiest way to keep up with this parade of technical information is by spending a definite number of hours each week in reading. But reading alone is not the answer. He must be selective. He must be objective. He must form good reading habits so that a wide field may be covered with the least investment of time.

The most efficient engineering organizations are those made up of competent engineers who, as a group, are well and continuously read in all the fields that affect their operations. If one staff member misses an idea, another picks it up. Nothing significant gets by.

What do they read? Society and conference papers, new books, the better newspapers and general magazines, but probably best of all, the business or technical publications. These have been designed specifically for the engineer. They are read with pleasure as well as profit.

Yes, there are still men who insist, "But I don't have *time* to read." Carroll Larabee, writing in *Printers' Ink*, hit them right between the eyes...

"Industry needs to turn wasting time into reading time. I hear a lot about the difficulty of finding time to read. I don't hear so much about the difficulty of cutting down on time-wasting conferences or hour-eating visitors. Or 3-hour lunches. Or inefficient office practices. Or fuzzy interoffice memos. Or memos that take 5,000 words to pass along a hundred words of information. If management doesn't insist its people keep up on business and technical literature, it's taking a long gamble that it won't lose out to the competitor with more alert executives."

McGraw-Hill has just published a booklet on "Engineered Business Reading." It shows how companies that encouraged key men to read business and technical publications moved ahead faster. It offers a suggestion on how "Engineered Business Reading" can be applied in any organization. If you'd like a copy, just drop a note to Bob Mattoon at PRODUCT ENGINEERING headquarters in the McGraw-Hill Building, New York 36, N. Y.—AH

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74 for Your Information (personal)

No place to hide

Looks like a rough year ahead for fish. The electronic know-how developed for aircraft and military instruments is being applied to spot the little flippers no matter where they go. This week, for instance, RCA is introducing a four-range cathode-ray type fish-finder especially adapted for shallow waters, and a small-craft "Lodar" system that will scan ocean depths both vertically and horizontally. Both units, RCA proudly points out, are designed for minimum space utilization and maximum service. The fish-finder features a detection transducer contained in a complete fairing assembly, easily mounted to the ship's hull, and is "completely electronic." The Loran unit is designed for both scope and recording-chart presentation, and has a vertical sounding range of 560 fathoms.

For junior scientists

To protect slides (and pocketbooks) from damage, Bausch & Lomb has a new microscope, priced about one-third below standard models but with a host of built-in features. A pre-focusing gage for the coarse focus reduces chance that the objective will be forced into the slide (and also saves time); the focusing slide is made of stainless steel "to minimize wear from friction"; an extended base prevents damage to nosepiece and eyepiece when the microscope is accidentally pushed against a wall; the eyepiece is locked in to prevent loss, but can be removed when desired. The unit is housed in a heavy metal case.

For home workshops

Priced at just $5.95, this new "electronic" soldering gun aims at protecting the consumer's pocketbook while providing him with an efficient tool. The manufacturer says it has "the most efficient transformer-type gun on the market." There is also a built-in spotlight, angled to focus on the work. The gun weighs only 19 oz, is made by Wen Products, Inc., 5810 Northwest Highway, Chicago 31.

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MISSILES

SENIOR HYDRAULIC ENGINEER

An interesting situation with a future in Raytheon's expanding missile program.

Background: 5-10 years in design of aircraft or missile hydraulic components, specifically . . . electro-hydraulic servo-valves, system servo analysis, optimization of servo-mechanism parameters. Should have EE or ME with special training in application of hydraulic servo-mechanisms.

For interview: please write to V. Crowninshield.

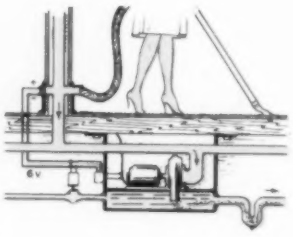
Raytheon Manufacturing Company
Missile Systems Division
Bedford, Massachusetts

RAYTHEON MISSILE SYSTEMS DIVISION

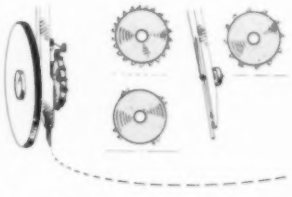
WHY DON'T THEY RESEARCH and DEVELOP...

. . . a retractable, arm-type safety seat belt for automobiles? The arm should be well padded, comfortably encompass the passenger, be easily and completely retractable, and extend automatically when the passenger seats himself. Once extended the arm would lock into place until manually released. Note vents in seat and back for fan-driven air. —H. J. Brikowski

. . . give household plumbing a modern look with a flexible, closed-cell, plastic insulating liner for water-closet storage tanks to prevent excess condensation? And how about a true disposal attachment to pulverize obstructions (dolls, towels, diapers, etc.) during the flushing operation of a water closet to prevent flooding the bathroom floor—ugh!—and who hasn't, eh? Why not add a flood-stage detector in a bowl recess to stop flow from the tank? —F. A. Phaneuf



. . . a built-in vacuum cleaner for homes. The unit would have a 2-hp ball bearing motor mounted in cellar or utility room. Low-friction plastic pipe would connect to convenient self-sealing wall outlets in all the rooms plus garage. The usual vacuum-cleaner attachments with extra-long hose would be connected to the outlet as desired. An automatic flushing system would flush dust and dirt into sewer line. A 6-volt control system would permit actuation from any outlet. Entire system should cost about $200 for houses under construction. —K. Kahn



. . . a drafting compass that will automatically produce dashed lines to represent hidden circles. Possibly a small rubber-tired wheel and a multi-lobed cam could alternately eject and withdraw the lead from within a protective sheath. Also, how about plastic drafting templets with dashed circles as well as solid ones. —T. N. Tyler

Have you a pet project but neither the time nor inclination to do the necessary R & D? Product Engineering will welcome (and pay $10 each for) similar ideas based on known scientific principles but lacking an inspired manufacturer

Simplify Fluid Line Installation in Confined Spaces with Aeroquip Elbow Hose Fittings and Assemblies

ELBOW FITTINGS AVAILABLE

Swivel Nut Ends—S.A.E & J.I.C.

QUIP 2651

90° Elbows (Long) for O.D. tube sizes from ¼" to 1".

IP 1509

90° Elbows (Short) for O.D. tube sizes from ¼" to 1".

IP 1503

45° Elbows for O.D. tube sizes from ¼" to 1"

Split Flange Ends—"O" Ring Shoulder

UIP 1509

90° Elbows for O.D. tube sizes from ½" to 2".

UIP 1509

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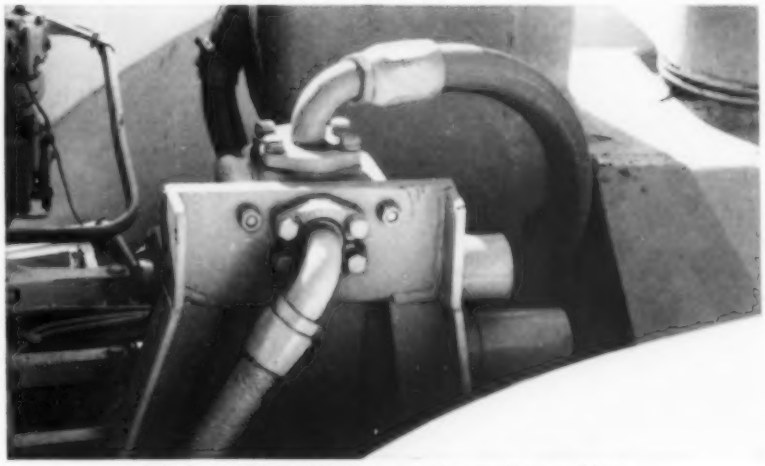
Standard 4-Hole Flange Ends

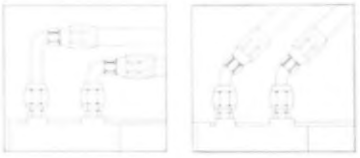
QUIP 1503

90° Elbows for 2½" & 3" O.D. pipe.



Split flange elbow fittings connecting medium and high pressure hydraulic lines on construction equipment.

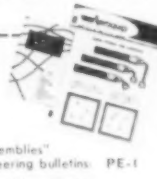
Where fluid line routing is complex and space is limited, hose assemblies with elbow fittings can be especially helpful to good design and simple installation. Elbow fittings provide fewer parts, adapters and joints, shorten assembly time,



and permit compact hose bends and contours without placing stress on the hose itself.

Aeroquip offers elbow fittings and hose for a wide range of industrial applications, in end connections to fit S.A.E. and J.I.C. swivel nut, standard flange and split flange systems. And, every Aeroquip Elbow Fitting is completely detachable from the hose. This permits reuse of the fitting again and again when making replacement hose lines, with substantial savings in maintenance time and money.

Full information on Aeroquip Reusable Elbow Fittings and Hose is available to product designers. Fill in and mail the coupon below for the engineering bulletins you want plus a handy guide for routing and installation of Aeroquip Hose Assemblies. Complete engineering assistance is available to manufacturers.



Aeroquip Corporation
Jackson, Michigan

Please send me a copy of "Guide for Routing and Installation of Aeroquip Flexible Hose Assemblies" plus the following engineering bulletins: PE-1

- ☐ IEB-3 on Split Flange Elbow Fittings
- ☐ IEB-27 on Swivel Nut Elbow Fittings

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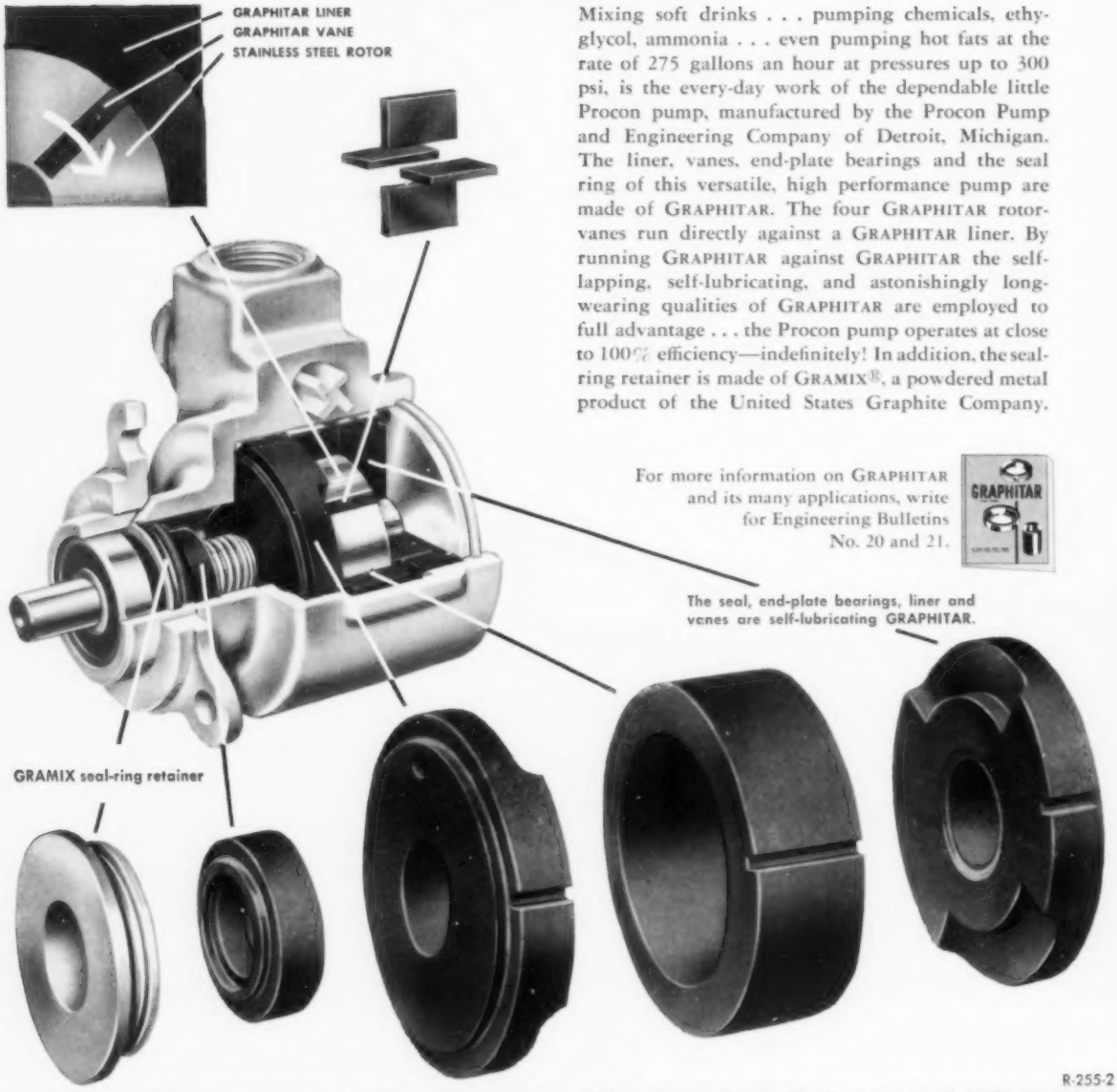
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R-255-2

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